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A MONOGRAPH OF THE GENUS CALOCHORTUS[1]

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The recent development of new techniques for the study of the biological entities which we term genera and species has created a renewed interest in taxonomy as a basic plant science. Modern taxonomy no longer concerns itself primarily with merely cataloguing, with appropriate binomials and brief diagnoses, the variants which do not fit into the pre-existing "pigeon holes," but is making a sincere attempt to understand the factors which make themselves evident through variation and speciation.

The development of the monographic method of plant taxonomy is largely responsible for this change of attitude. The plant kingdom, as a whole, is so inconceivably vast, that it is only by the comparative study of a limited group of related entities that we are able to secure any understanding of the laws which must govern the entire assemblage of groups. It was with this fact in mind that the genus *Calochortus* was selected as the subject of the present study.

This genus is admirably suited to such an investigation. In

[1] An investigation carried out at the Missouri Botanical Garden in the Graduate Laboratory of the Henry Shaw School of Botany of Washington University and submitted as a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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the first place, it is a moderately small group, with a greatly restricted distribution, thus lending itself to field study. Its fifty-seven known species are found only in western North America, from southern British Columbia to Guatemala, eastward to western Nebraska and the Dakotas. Throughout this region it is quite common, often abundant, so that herbarium material of most of the species is available in quantity for comparative studies. The individual species are also often greatly restricted in distribution, sometimes occurring only locally, with the result that their areas of distribution furnish critical evidence as to their probable phylogenetic relationships. Another important consideration is the comparative ease with which the facts from cytogenetics may be made available for correlation with those from morphology and distribution. Furthermore, the genus may be successfully cultivated, and observations from the field and herbarium confirmed in the garden. Lastly, certain of the species are exceedingly variable, notoriously difficult, and have been poorly understood. This fact alone would justify the present investigation.

HISTORY

The genus *Calochortus* was proposed by Pursh[2] in 1814 to accommodate a single species, *C. elegans,* secured by Lewis and Clark "on the headwaters of the Kooskoosky," in what is now the state of Idaho. In the original publication, Pursh refers to an account of the genus in volume eleven of the 'Transactions of the Linnean Society of London,' which account appears never to have been published.

Two years later, Humboldt, Bonpland and Kunth[3] described two additional species which are now included in this genus, basing their descriptions on specimens collected in Mexico by Humboldt and Bonpland. These were placed in the genus *Fritillaria,* under the names, *F. purpurea* and *F. barbata.* The latter was questionably referred here, and in 1828, Don[4] segregated it under the generic name, *Cyclobothra.*

[2] Pursh, Fl. Am. Sept. 1: 240. 1814.
[3] Humboldt, Bonpland & Kunth, Nov. Gen. & Sp. Pl. 1: 288. 1816.
[4] [D. Don in] Sweet, Brit. Fl. Gard. 3: *t. 273.* 1828.

During his explorations in the region of the Columbia River, Douglas rediscovered *C. elegans,* and found three additional species of the genus. Two of these, *C. macrocarpus* and *C. nitidus,* he named, described and illustrated in 1828, while the third, of which he had been unable to preserve material, he described briefly, but did not name.[5]

The following year, Schultes,[6] in a scholarly treatise, delimited the genus as it is at present understood, transferring to it *Fritillaria barbata* and *F. purpurea,* but changing their names, as was the custom at the time, to *Calochortus flavus* and *C. Bonplandianus,* respectively. At the same time, he recognized all of the previously described species, and proposed the name *C. Douglasianus* for the unnamed species which Douglas had described. He also proposed two new species from Mexico, *C. pallidus* and *C. fuscus.* In 1830, this treatment was published again in slightly emended form.[7]

On his second expedition to western North America, Douglas collected a number of additional species, which he sent to the Horticultural Society of London under the manuscript names, *C. luteus, C. splendens, C. venustus, C. pulchellus* and *C. albus.* The first of these was published by Lindley[8] in 1833, thus antedating by a year Nuttall's[9] use of the same name for another species. The remainder were published by Bentham[10] in 1834. In his paper, however, Bentham made the error of referring the latter two species to the newly established genus *Cyclobothra,* in which he also included *Calochortus elegans,* the type species of the earlier genus. Later in the same year, Lindley[11] continued Bentham's misinterpretation by transferring all of the *Calochorti* with nodding flowers to *Cyclobothra,* and added two new species, *C. paniculata* and *C. lutea.* In 1843, Kunth[12] maintained both genera, recognizing five species of *Calochortus* and twelve of *Cyclobothra.*

[5] Douglas in Trans. Hort. Soc. Lond. 7: 275–280, *pls. 8–9.* 1828.
[6] Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. 4: 123–134. 1829.
[7] Schultes & Schultes, Syst. Veg. 7: 1530–1536. 1830.
[8] Lindley in Bot. Reg. 19: *t. 1567.* 1833.
[9] Nuttall in Journ. Acad. Philad. 7: 53. 1834.
[10] Bentham in Trans. Hort. Soc. Lond. Ser. II. 1: 411–413, *pls. 14–15.* 1834.
[11] Lindley in Bot. Reg. 20: under *t. 1661–1663.* 1834.
[12] Kunth, Enum. Pl. 4: 227–233. 1843.

The thirty years following the publication of Kunth's compilation added very little to our knowledge of *Calochortus*. A few new species were described, and some old ones given new names. In America, particularly, there was extreme confusion, and the literature offers little but misdeterminations. The most pretentious contribution of the period is that of Wood,[13] in which the name *Calochortus* is revived in its original sense, and twelve species of the Pacific Coast are recognized.

The first significant attempt at a long-needed revision of *Calochortus* is that of Baker[14] in 1874. Here the genus is divided into four subgenera, including a total of twenty-one species and several varieties. Baker was handicapped by a lack of material, but his revision was carefully done, and, with few exceptions, the species which he accepted stand to-day as he delimited them.

Five years later, 1879, another important contribution, that of Watson,[15] appeared. With more copious material, though still meagre as compared to that available to-day, Watson was able to correct many of Baker's errors. He divided the genus into three sections, and maintained a total of thirty-two species. This is the last attempt to treat *Calochortus* as a whole before the present one. A year later, 1880, Watson[16] again published his treatment, with the Mexican species excluded.

The period between 1880 and 1900 was characterized by intensive botanical exploration in the West and the discovery of a number of new species of *Calochortus*. In 1901, Purdy[17] presented a revision of the genus, based primarily on his own extensive experience with it, both in the field and in his garden. This treatment is remarkable in that its author had a more detailed knowledge of many of the species than any previous or subsequent writer. The taxonomy, however, is essentially that of Watson in his 'Botany of California,' brought up to date. Purdy recognized a total of forty species, exclusive of those of Mexico, most of which are accepted in the present treatment.

[13] Wood in Proc. Acad. Philad. [20]: 167–169. 1868.
[14] Baker in Journ. Linn. Soc. Lond. Bot. 14: 302–310. 1874.
[15] Watson in Proc. Am. Acad. 14: 262–268. 1879.
[16] Watson, Bot. Calif. 2: 171–177. 1880.
[17] Purdy in Proc. Calif. Acad. Ser. III. Bot. 2: 107–158, *pls. 15–19*. 1901.

In 1911, Painter[18] published a revision of the section CYCLOBOTHRA, including therein ten Mexican species, but omitting the closely related Californian ones.

At least two more recent treatments are of importance in that they include a considerable portion of the known species. The first of these is that of Jepson,[19] in which he accepts twenty-four species in California, and the second is that of Abrams,[20] which includes forty-one species for the three Pacific Coast states.

In the present monograph, the genus is divided into three sections and twelve subsections, and a total of fifty-seven species and thirteen varieties recognized. The sectional and subsectional alliances in the genus *Calochortus*, in the order in which they are treated are as follows:

Section I. EUCALOCHORTUS
- Subsection 1. PULCHELLI
- Subsection 2. ELEGANTI
- Subsection 3. NUDI
- Subsection 4. NITIDI

Section II. MARIPOSA
- Subsection 5. VENUSTI
- Subsection 6. MACROCARPI
- Subsection 7. NUTTALLIANI
- Subsection 8. GUNNISONIANI

Section III. CYCLOBOTHRA
- Subsection 9. WEEDIANI
- Subsection 10. GHIESBREGHTIANI
- Subsection 11. BARBATI
- Subsection 12. PURPUREI

MORPHOLOGY

The species of *Calochortus* are all more or less succulent herbs from perennial, tunicated bulbs. The genus, as a whole, presents much diversity in morphology, and the species, for the most part, are easily recognized. Some few, however, are extremely variable and difficult to delimit. The following characters have been found to be of taxonomic value:

Bulbs.—In shape, the bulbs of *Calochortus* are more or less

[18] Painter in Contrib. U. S. Nat. Herb. **13**: 343–350. 1911.

[19] Jepson, Fl. Calif. 1: 291–302, *figs. 51–57*. 1921; Man. Fl. Pl. Calif. pp. 230–239. 1923.

[20] Abrams, Illust. Fl. Pac. States 1: 431–446. 1923.

ovoid. Those of the sections EUCALOCHORTUS and MARIPOSA are membranaceous-coated, while those of CYCLOBOTHRA have fibrous-reticulate coats.

Stems.—The stems are either scapiform or leafy, and not infrequently branched. They are always glabrous and often glaucous.

Leaves.—The leaves are usually broadly to narrowly linear, attenuate and usually glabrous or glaucous. There is a single basal leaf, which in the sections EUCALOCHORTUS and CYCLOBOTHRA is often conspicuous and usually present at anthesis. In MARIPOSA, on the other hand, it is less conspicuous and is rarely persistent until flowering time. Due to the short lower internodes, some species of this section may appear to have several basal leaves. The cauline leaves, when present, are alternate and successively reduced upward. They are variable in outline, from linear to lanceolate, and acute to attenuate.

Bulblets.—Many of the species of the section MARIPOSA and two of those of EUCALOCHORTUS normally bear solitary bulblets in the axils of the lowermost cauline leaves or leaf, at or below the surface of the ground. In the section CYCLOBOTHRA the bulblets, if present, are not solitary, and are borne in the axils of the upper leaves and bracts.

Inflorescence.—The inflorescence of *Calochortus* is a more or less reduced monochasium. Certain species, for instance *C. catalinae* and its near allies, have a well-developed monochasium, but in most of the species of the section MARIPOSA, and all those of EUCALOCHORTUS and CYCLOBOTHRA, the internodes do not elongate, and the inflorescence appears subumbellate. This character should be of phylogenetic importance, but its fullest significance does not seem clear.

Bracts.—The bracts usually equal in number, and in all cases are opposite, the flowering pedicels which they subtend. In those species with subumbellate inflorescences, that which appears to be the lowermost bract is morphologically the uppermost cauline leaf.

Flowers.—In shape, the flowers of *Calochortus* vary from narrowly campanulate or subglobose to broadly campanulate. They are erect, spreading or nodding. In color, they are ex-

ceedingly varied, from white to yellow, red, purple, bluish, and reddish or purplish brown, often with the petals and sepals marked with contrasting colors. The perianth consists of two series of three segments each. The outermost series, being sepaloid, are, for convenience, referred to as "sepals," while the innermost, which are petaloid, are hereafter called "petals." In aestivation, the sepals are ultimately valvate and the petals convolute.

Sepals.—The sepals, in most cases, are lanceolate, obtuse to attenuate, and glabrous or rarely sparsely bearded on the inner face. In some species, there is a glandular spot near the base, similar to the gland on the petals.

Petals.—The petals are usually narrowly to broadly obovate, cuneate or clawed, and obtuse or acute. In many species in the sections EUCALOCHORTUS and CYCLOBOTHRA, they are conspicuously bearded. In MARIPOSA, however, in the subsections NUDI and NITIDI of EUCALOCHORTUS, and in the subsections GHIESBREGHTIANI and PURPUREI of CYCLOBOTHRA, they are essentially naked, except in the vicinity of the gland.

Gland.—Near the base of each petal in nearly all species of *Calochortus,* there is a unique structure known in taxonomic literature as the "gland" or "foveola." It does not seem to be always glandular, and is even less frequently foveolate, but in the absence of a better term, it is uniformly called the "gland" throughout the present treatment. The gland presents the most critical characters for the differentiation of species, and many entities can be recognized by a single petal.

Stamens.—The stamens are six in number, in two cycles of three. The filaments are more or less subulate, dilated at the base, and slightly adnate to the perianth segments. The anthers are cylindrical, oblong to linear, obtuse to long-apiculate, and prolonged as a tubular sheath below the insertion of the filaments.

Pistil.—The pistil is tricarpellary and trilocular. The ovary is oblong to linear, more or less triangular to 3-winged, abruptly contracted or tapering to a persistent, trifid stigma. A definite style is usually not evident. The ovules are numerous, in two rows in each loculus, and completely anatropous.

Fruit.—The fruit of *Calochortus* is an erect to nodding capsule, which is at first septicidally, but later often also loculicidally, dehiscent. In the section EUCALOCHORTUS and in *C. catalinae* of the section MARIPOSA, it is narrowly to broadly 3-winged, and from suborbicular to oblong in outline. In all other species it is at most 3-angled, and linear or nearly so.

Seeds.—The seeds are either irregular or flattened, and are usually minutely hexagonally reticulate.

CYTOLOGY

The present cytological knowledge of the genus *Calochortus* is not extensive, but is very valuable in the interpretation of morphological and geographical evidence in that it gives an indication as to the nature of the internal factors which have brought about speciation. In 1926, Newton[21] reported briefly on the number and morphology of the chromosomes in ten species, and in 1939, Beal[22] confirmed most of Newton's work, and added details for eighteen additional species. During the course of the present investigation, the writer has studied cytological material of most of the *Calochorti* indigenous to the United States. In so far as this project is not complete, however, it is proposed to defer the presentation of additional data to a subsequent paper. It should be stated, nevertheless, that all new data are in accord with the classification here outlined, and with the findings of Newton and Beal which are summarized in the following table, where the reported haploid and diploid chromosome numbers follow the name of the species as given in the present treatment.

Section I. EUCALOCHORTUS

Subsection 1. PULCHELLI	n	2n
C. amoenus	10	20
C. albus	10	20
C. amabilis	10	20

[21] Newton, W. C. F. Chromosome studies in *Tulipa* and some related genera. Journ. Linn. Soc. Lond. Bot. 47: 339–354. 1926.

[22] Beal, J. M. Cytological studies in relation to the classification of the genus *Calochortus*. Bot. Gaz. 100: 528–547. 1939.

Subsection 2. ELEGANTI			
C. monophyllus (Benthami)	10		20
C. Tolmiei (incl. *Maweanus)*	10		20
C. elegans	—		20
C. elegans var. *selwayensis*	—		20
C. apiculatus	10		20
Subsection 3. NUDI			
C. uniflorus	20		40
C. nudus	—		20
Subsection 4. NITIDI			
C. Douglasianus (pavonaceus)	20		40
C. nitidus	—		20
C. persistens (C. Greenei Hort., not Watson)	—		20
C. Howellii	10		20
C. Lyallii	10		20
Section II. MARIPOSA			
Subsection 5. VENUSTI			
C. catalinae	7		14
C. splendens	7		14
C. venustus	7		14, 21
C. superbus	6, 7		12, 14
C. luteus	7, 10		14, 20, 21
C. Vestae	14		28
C. Leichtlinii	—		14
Subsection 6. MACROCARPI			
C. macrocarpus	—		14
Subsection 7. NUTTALLIANI			
C. clavatus	—		16
C. Kennedyi	—		16
C. Nuttallii	—		16
C. Nuttallii var. *aureus*	—		32
Subsection 8. GUNNISONIANI			
C. Gunnisoni	—		18
Section III. CYCLOBOTHRA			
Subsection 9. WEEDIANI			
C. Plummerae	9		18

From the above table, the following facts are evident: (1) The basic chromosome number in the section EUCALOCHORTUS is ten, with two known cases of tetraploidy. (2) In the section MARIPOSA, the basic number may be six, seven, eight or nine. In the subsection VENUSTI it is usually seven, with one count of six, and two instances of triploidy and one of tetraploidy. In the subsection MACROCARPI, it is seven; in the NUTTALLIANI,

eight, with one tetraploid variety; and in the GUNNISONIANI, nine. (3) In the section CYCLOBOTHRA, the basic chromosome number of the single species investigated is nine.

DISTRIBUTION

The genus *Calochortus* is restricted in its geographical distribution to western North America, from southern British Columbia, southward to Guatemala, and eastward to western Nebraska and the Dakotas. Throughout this vast region, there is rarely an area of any considerable size without one or more indigenous species. The greatest specific concentration occurs in the state of California, within the boundaries of which over one-half of the species are found.

For the most part, the species are definitely xerophytic, preferring dry, rocky slopes or desert hills as a habitat. Some, however, are more mesophytic, and a few grow in meadows which are wet for at least a part of the year. These and other ecological requirements of the various entities have apparently greatly limited them in their ability to adapt themselves to different situations. As a result, their distributional areas are usually limited, sometimes local, in extent, so that they offer valuable evidence as to probable phylogenetic relationships.

Although it is very likely that the present-day species have evolved within the areas which they now occupy, or in closely adjacent areas which are no longer suited to their requirements, an examination of the geographical aspects of the sectional and subsectional groups is both interesting and instructive. The section EUCALOCHORTUS, for instance, is widely distributed in the mountainous regions of the Northwest, from the Rocky Mountains of western Montana and Alberta, across southern British Columbia to the Cascade Range, and southward to southern California. The center of diversity is in northern California and adjacent Oregon, apparently coincident with the ancient Klamath land area. From here the lines of morphological and geographical affinity can be traced, first, northward along the Cascade Axis and inner foothills of the Oregon Coast Range, second, northeastward across the Colum-

bian Plateau to the northern Rocky Mountains, and third, southward along the Sierra Nevada and Coast Ranges of California. Specific representatives of three subsections of EUCALOCHORTUS are to be found within this Klamath area, while the fourth, the PULCHELLI, are found only to the south of it. From this center, the ELEGANTI are distributed in all directions, the NITIDI to the east and northeast, and the NUDI principally to the south.

The center of diversity of the section MARIPOSA is not so well defined as that of EUCALOCHORTUS, but seems to be located somewhere in the mountains or deserts of southern California, perhaps in the San Gabriel Mountains. From here the lines of affinity can be traced northward along the Coast Ranges and Sierra Nevada, southward in the mountains along the coast, and eastward or northeastward across the deserts to the Rocky Mountains and the northern Great Plains. The subsection VENUSTI is almost entirely confined to California, whereas the subsection NUTTALLIANI is widespread from southern California eastward to the Rocky Mountains, and northeastward to the Dakotas. Of the two species of the subsection GUNNISONIANI, one is found in the desert regions of New Mexico and Arizona, while the other occurs in the Rocky Mountains from New Mexico northward to Montana. The single species assigned to the subsection MACROCARPI has a Columbian Plateau distribution similar to the subsection NITIDI of the section EUCALOCHORTUS.

With the exception of the subsection WEEDIANI, the exact distributional areas of the various entities of the section CYCLOBOTHRA are too poorly known for comparison with those of the other sections. The subsection WEEDIANI is closely limited to its center of diversity, which is essentially similar to that of the section MARIPOSA. The remaining three subsections of the section CYCLOBOTHRA are distributed entirely to the south of any other representatives of the genus. Their center of diversity seems to be on the southern part of the Mexican Plateau, whence they appear to have dispersed, both to the north and to the south.

The geographical evidence presented above strongly supports that from morphology and cytology, and indicates that the three sections herein recognized are natural groups of long standing.

GENERIC RELATIONSHIP

Calochortus, as a genus, differs considerably in its morphology and cytology from all other genera in the subfamily Lilioideae and tribe Tulipeae of the family Liliaceae, in which it has been placed by most recent authors. From these it may be distinguished by its sepaloid outer perianth segments, short or obsolete style, septicidal capsule, and its varying chromosome base number, which is never twelve, the usual number of all other genera of this alliance. Although these differences are significant, they do not seem to justify segregating *Calochortus* as a monotypic family, the Calochortaceae, as has been done by some recent American botanists. In general appearance, some species are not unlike certain representatives of the genus *Fritillaria,* but the relationship of the genus as a whole, although remote, is probably rather with the genus *Tulipa.*

SPECIFIC CONCEPT[23]

In the present treatment, every effort has been made to delimit the species as morphologically different natural populations. It is the contention of the author that such entities, although at times perplexingly variable, are the only satisfactory basis for the application of taxonomic names. Natural populations are defined by barriers, either external or internal, which, when once established, allow divergent evolution in the two or more groups so separated, and effectively prevent genetic intermingling between them. All factors which prevent genetically compatible populations from interbreeding are included as external barriers. These may be geographical where the areas of distribution of the entities are not continuous, ecological where the entities occupy different habitats within the

[23] See also Clausen, Jens, David D. Keck and William M. Hiesey. The concept of species based on experiment. Am. Journ. Bot. **26**: 103–106. 1939, and the references there cited.

same area, or seasonal where the entities grow together, but flower at different seasons of the year. As internal barriers are included those changes in the germ-plasm which in themselves cause incompatibility. Such cytological phenomena as polyploidy, inversions and translocations fall into the second class.

Where the barrier is weak, or has been broken down, more or less hybridization may occur. These cases present special difficulties, but in *Calochortus,* fortunately, they are rare. If the hybrid is partially or completely sterile, or the area of hybridization limited, particularly if both parent entities occur outside of this area in pure or nearly pure condition, it seems best to recognize both as of specific rank (cf. *C. nudus* and *C. minimus; C. luteus* and *C. superbus.* If, on the other hand, hybridization has completely submerged either or both parents, so that its or their existence becomes more or less hypothetical, then the population is probably better considered as a single, variable entity. *C. venustus* is a possible example in *Calochortus.*

Another factor which has given rise to variable species is incomplete isolation, which allows local or regional populations to diverge, but prevents their complete separation by allowing occasional genetic intermingling. This is a frequent phenomenon in *Calochortus.* Such species as *C. Nuttallii, C. Tolmiei, C. barbatus, C. purpureus, C. albus,* and many others are broken up into numerous local or regional facies. In many genera such variants have been given taxonomic rank as subspecies, but in *Calochortus* they are so frequent and so poorly defined that recognition, even in subspecific rank, would lead to confusion. In some instances, however, it has seemed necessary to designate outstanding variants of either this or other categories. In these cases, the noncommittal status "variety" has been employed.

Phylogeny

The evidence from the standpoints of morphology, geographical distribution and cytology, presented in the present

paper, seems to justify the following conclusions as to the phylogeny of the genus *Calochortus*.

1. The genus is one of long standing. This point is supported by the lack of close generic relatives, its great morphological and cytological variation and its well-marked sections, subsections and species, each with a characteristic geographical range.

2. The evolutionary pattern has been essentially dendroid. Reticulate relationships between the species are apparently of recent origin, and have not affected the evolutionary pattern as a whole. There is no evidence for linear or orthogenetic development.

3. Speciation has been brought about by the combined action of competition and natural selection on independently varying natural populations, limited by internal or external barriers. In this way, evolution has been able to proceed in different directions within two closely related populations.

4. Primitive and advanced characters occur at random throughout the genus, and are of little value in the determination of the relative position of a given entity. For this reason, the sequence of sections, subsections, and species in the following treatment is admittedly artifical. Every effort, however, has been made to group related entities together.

Economic Importance

The bulbs of *Calochortus* are edible, and were used as food by the American Indians. They are crisp and starchy, and taste not unlike an ordinary potato tuber. Most of the species have been cultivated as ornamental garden plants, but have never been very popular in this country, due, no doubt, to the fact that they soon die out if not properly cared for, especially during the summer months.

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Abbreviations

The herbaria from which material has been available for study and from which specimens are cited in this treatment are indicated by the following abbreviations:

CA—California Academy of Sciences Herbarium.
Clokey—Personal Herbarium of Ira W. Clokey.
D—Dudley Herbarium of Stanford University.
F—Field Museum of Natural History Herbarium.
G—Gray Herbarium of Harvard University.
Kew—Herbarium of the Royal Botanic Gardens, Kew.
M—Missouri Botanical Garden Herbarium.
NY—New York Botanical Garden Herbarium.
O—Personal Herbarium of the author.
P—Pomona College Herbarium.
PA—Herbarium of the Academy of Natural Sciences of Philadelphia.
RM—Rocky Mountain Herbarium of the University of Wyoming.
UC—University of California Herbarium, Berkeley.
UCLA—University of California Herbarium, Los Angeles.
UM—Montana State University Herbarium.
UO—University of Oregon Herbarium.
US—United States National Herbarium.
WS—State College of Washington Herbarium.
WU—Willamette University Herbarium.

Taxonomy

Calochortus Pursh, Fl. Am. Sept. **1**: 240. 1814; Douglas in Trans. Hort. Soc. Lond. **7**: 275–280, *pls. 8–9.* 1828; Schultes f.

in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 123–134. 1829; Schultes & Schultes, Syst. Veg. **7**: 1530–1536. 1830; Bentham in Trans. Hort. Soc. Lond. Ser. II. **1**: 411–412, *pl. 15, figs. 1, 3.* 1834; Kunth, Enum. Pl. **4**: 231–233. 1843; Wood in Proc. Acad. Philad. [**20**]: 167–169. 1868; Baker in Journ. Linn. Soc. Lond. Bot. **14**: 302–310. 1874; Watson in Proc. Am. Acad. **14**: 262–268. 1879; Bot. Calif. **2**: 171–177. 1880; Bentham & Hooker, Gen. Pl. **3**: 820. 1883; Hemsley, Biol. Centr.-Am. Bot. **3**: 379–380. 1885; Engler in Engler & Prantl, Nat. Pflanzenf. 2^5: 63. 1887; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 107–158, *pls. 15–19.* 1901; Piper in Contrib. U. S. Nat. Herb. **11** [Fl. Wash.]: 193–195. 1906; Nelson in Coulter & Nelson, New Man. Bot. Centr. Rocky Mts. pp. 116–117. 1909; Painter in Contrib. U. S. Nat. Herb. **13**: 343–350. 1911; Purdy & Bailey in Bailey, Stand. Cyclop. Hort. **2**: 631–635. 1914; Wooton & Standley in Contrib. U. S. Nat. Herb. **19** [Fl. N. Mex.]: 127–128. 1915; Rydberg, Fl. Rocky Mts. & Adj. Plains, pp. 171–172. 1917; Jepson, Fl. Calif. **1**: 291–302, *figs. 51–57.* 1921; Man. Fl. Pl. Calif. pp. 230–239. 1923; Abrams, Illust. Fl. Pac. States **1**: 431–446. 1923; Tidestrom in Contrib. U. S. Nat. Herb. **25** [Fl. Utah & Nev.]: 124–125. 1925; Krause in Engler & Prantl, Nat. Pflanzenf. 2. aufl. **15a**: 337–338. 1930; Wehrhahn, Gartenstaud. **1**: 141–147. 1931; Rydberg, Fl. Prairies & Plains Centr. N. Am. pp. 223–224. 1932; Munz, Man. So. Calif. Bot. pp. 91–95. 1935.

Cyclobothra [D. Don in] Sweet, Brit. Fl. Gard. **3**: *t. 273.* 1828; Bentham in Trans. Hort. Soc. Lond. Ser. II. **1**: 412–413, *pl. 14, figs. 1, 3.* 1834; Lindley in Bot. Reg. **20**: *t. 1661–1663.* 1834; Kunth, Enum. Pl. **4**: 227–231. 1843.

Glabrous herbs from perennial, tunicated bulbs, with membranaceous or fibrous-reticulate coats; stems scapiform or leafy, often branched, frequently bulbiferous either in the axils of the lower cauline leaves, at or beneath the surface of the ground, or in the axils of the upper leaves and bracts; leaves usually linear, the solitary basal ones often conspicuous, the cauline ones successively reduced upward; inflorescences monochasial or subumbellate through the failure of the internodes to elongate, the bracts usually equalling the flowering pedicels

in number and opposite them; flowers conspicuous, erect or nodding, globose to broadly campanulate, white, yellow, red, purple, bluish or brownish, often marked with contrasting colors; outer perianth segments (sepals) three, ultimately valvate in aestivation, more or less sepaloid, oblong to lanceolate, obtuse to attenuate, usually naked; inner perianth segments (petals) three, convolute in aestivation, obovate to lanceolate, cuneate to clawed, usually more or less bearded on the inner face, and characteristically with a unique depression or glandular spot (the gland) near the base; stamens six, in two series, anthers oblong to linear, obtuse to long-apiculate, the base prolonged below the insertion of the filaments as a tubular sheath, filaments subulate, basally dilated, slightly adherent at the base to the perianth segments; pistils tricarpellary, trilocular, ovaries triangular to 3-winged, abruptly contracted or tapering to a persistent, trifid stigma; ovules anatropous, in two rows in each loculus; fruits orbicular to linear, 3-angled to 3-winged, erect or nodding, septicidally dehiscent; seeds irregular or flattened, usually with inconspicuously hexagonally reticulate coats.

TYPE SPECIES: **Calochortus elegans** Pursh.

KEY TO THE SECTIONS

A. Fruits orbicular to oblong, 3-winged; inflorescences subumbellate.....Section I. EUCALOCHORTUS

AA. Fruits oblong to linear, usually 3-angled; if winged, inflorescences monochasial.

B. Bulb-coats membranaceous.....Section II. MARIPOSA

BB. Bulb-coats fibrous-reticulate.....Section III. CYCLOBOTHRA

KEY TO THE SUBSECTIONS, SPECIES AND VARIETIES

Section I. EUCALOCHORTUS

a. Fruits usually nodding; if erect, stems scapiform *(C. nudus)*.

b. Flowers globose to narrowly campanulate, nodding.....Subsection 1. PULCHELLI

c. Flowers white to purple; petals not conspicuously fringed; glands traversed by several broad membranes.

d. Lower membranes of glands extending entirely across the base of the petals and decurrent along the margins.....*1. C. amoenus*

dd. Lower membranes extending only ⅓ to ⅔ the breadth of the petals.....*2. C. albus*

cc. Flowers yellow; petals conspicuously fringed; gland-membranes lacking.
d. Surface of the petals sparsely clothed to the tip with short hairs. ..... *3. C. pulchellus*
dd. Surface of the petals nearly naked, occasionally with a few hairs near the gland ..... *4. C. amabilis*
bb. Flowers broadly campanulate, erect or spreading.
c. Petals clawed, ciliate and more or less densely bearded ..... Subsection 2. ELEGANTI
d. Petals yellow ..... *5. C. monophyllus*
dd. Petals white, cream-colored, or variously marked or shaded with purple or rose.
e. Stems usually branched, or at least with a bract-like cauline leaf. ..... *6. C. Tolmiei*
ee. Stems scapiform, rarely branched.
f. Glands lunate, ½ to nearly as broad as the claw.
g. Petals conspicuously fringed, inner face not papillose.
h. Anthers large, oblong, acute ..... *7. C. coeruleus*
hh. Anthers smaller, lanceolate, acute to apiculate.
i. Petals ciliate to the apex ..... *7a. C. coeruleus* var. *nanus*
ii. Petals ciliate laterally only ..... *7b. C. coeruleus* var. *Westoni*
gg. Petals less conspicuously fringed, inner face minutely papillose.
h. Upper gland-membranes lacking; sepals without a basal, glandular spot.
i. Gland-membranes deeply fringed.
j. Glands strongly arched upward ..... *8. C. elegans*
jj. Glands straight or only slightly arched ..... *8a. C. elegans* var. *selwayensis*
ii. Gland-membranes erose to crenate ..... *8b. C. elegans* var. *oreophilus*
hh. Upper gland-membranes present; sepals with a basal, glandular spot ..... *9. C. Lobbii*
ff. Glands short, nearly circular ..... *10. C. apiculatus*
cc. Petals cuneate, not ciliate, glabrous or nearly so ..... Subsection 3. NUDI
d. Stems leafy, the lower internodes sometimes very short.
e. Internodes elongate; stems branched, usually not bulbiferous .... *11. C. umbellatus*
ee. Internodes very short; pedicels elongate; stems usually unbranched, bulbiferous ..... *12. C. uniflorus*
dd. Stems scapiform.
e. Fruits nodding; petals acute ..... *13. C. minimus*
ee. Fruits erect; petals rounded ..... *14. C. nudus*
aa. Fruits usually erect; if nodding, stems not scapiform *(C. persistens)* ..... Subsection 4. NITIDI
b. Fruits erect; anthers obtuse to short-apiculate.
c. Petals obovate, cuneate at the base.
d. Hairs on face of petals long and flexuous, sometimes sparse; gland-processes usually papillose, but not branched.
e. Lower internodes very short; stems bulbiferous .. *15. C. longebarbatus*

ee. Lower internodes elongate; stems not bulbiferous.
f. Glands triangular-lunate, slightly depressed.
g. Petals purplish, with a basal crescent-shaped spot.....16. *C. Douglasianus*
gg. Petals white or purplish, with a central purple blotch.....17. *C. nitidus*
ff. Glands lunate, deeply depressed; petals purplish, with a basal crescent-shaped spot.....18. *C. Greenei*
dd. Hairs on face of petals short; gland-processes branched..19. *C. Howellii*
cc. Petals triangular-lanceolate, conspicuously clawed.....20. *C. Lyallii*
bb. Fruits nodding; anthers apiculate.....21. *C. persistens*

Section II. MARIPOSA
a. Glands not depressed (or rarely slightly so), never surrounded with a membrane.....Subsection 5. VENUSTI
b. Inflorescences distinctly monochasial, the internodes sometimes short, but evident.
c. Capsules oblong, narrowly 3-winged, obtuse.....22. *C. catalinae*
cc. Capsules lanceolate or linear, 3-angled, acute.
d. Capsules lanceolate; stems usually flexuous-twining....23. *C. flexuosus*
dd. Capsules linear, stems erect.
e. Gland-processes linear or subclavate.
f. Gland-processes linear; petals with a reddish brown spot above the gland..... 24. *C. Dunnii*
ff. Gland-processes subclavate; petals without a spot above the gland.....25. *C. Palmeri*
ee. Gland processes enlarged and fungoid distally.....26. *C. splendens*
bb. Inflorescences obscurely monochasial, subumbellate.
c. Anthers not sagittate at the base.
d. Gland oblong, with long, slender gland-processes.
e. Petals conspicuously striate, not spotted.....27. *C. striatus*
ee. Petals not striate, with a conspicuous, dark red spot above the gland.....28. *C. monanthus*
dd. Glands not oblong, with shorter thicker processes.
e. Glands quadrate.....29. *C. venustus*
ee. Glands A-shaped.....30. *C. superbus*
eee. Glands doubly lunate.....31. *C. Vestae*
eeee. Glands simply lunate; petals yellow.....32. *C. luteus*
cc. Anthers more or less sagittate at the base.....33. *C. Leichtlinii*
aa. Glands more or less depressed, surrounded with a membrane.
b. Sepals usually greatly exceeding the petals; anthers linear.....Subsection 6. MACROCARPI
c. Petals purple, with or without a spot above the gland...34. *C. macrocarpus*
cc. Petals white, with a reddish purple crescent above the gland.....34a. *C. macrocarpus* var. *maculosus*
bb. Sepals rarely exceeding the petals; anthers oblong to lanceolate.
c. Glands circular; membrane broad, usually continuous; hairs on face of petals not branched.....Subsection 7. NUTTALLIANI
d. Flowers white to purplish.

e. Petals with a conspicuous, reddish brown or purple spot or band above the gland.

f. Face of petals sparsely bearded near the gland with slender hairs; petals usually without a median, longitudinal, green stripe.....*35. C. Nuttallii*

ff. Face of petals glabrous, or with a few short hairs near the gland; petals with a median, longitudinal, green stripe.....*35a. C. Nuttallii* var. *bruneaunis*

ee. Petals without a spot above the gland.

f. Basal leaves withering before anthesis; plants of dry slopes.

g. Flowers large; petals broadly obovate; Panamint Mountains, Inyo County, California....*35b. C. Nuttallii* var. *panamintensis*

gg. Flowers usually smaller; petals narrower; southern Sierra Nevada and South Coast Ranges, to southern California.....*36. C. invenustus*

ff. Basal leaves persistent at anthesis; plants of moist meadows, Inyo County, California.....*37. C. excavatus*

dd. Flowers yellow to vermillion.

e. Hairs on face of petal not enlarged distally.

f. Stems low, usually bulbiferous; desert regions of northwestern New Mexico, northeastern Arizona and southern Utah.....*35c. C. Nuttallii* var. *aureus*

ff. Stems taller, rarely bulbiferous; mountains of southern California, southward.....*38. C. concolor*

ee. Hairs on face of petals distally enlarged or subclavate.

f. Hairs on face of petals merely thickened distally; flowers yellow to vermillion.....*39. C. Kennedyi*

ff. Hairs on face of petals subclavate; flowers yellow.

g. Stems slender; flowers small; San Gabriel Mountains.....*40a. C. clavatus* var. *gracilis*

gg. Stems stout; flowers large; Los Angeles County, northward to central California.....*40. C. clavatus*

cc. Glands transversely more or less oblong; membrane narrow and discontinuous; hairs on face of petals branched and gland-tipped.....Subsection 8. GUNNISONIANI

d. Glands short, transverse; anthers usually obtuse.....*41. C. ambiguus*

dd. Glands transversely oblong; anthers acute to apiculate.

e. Petals white or purplish.....*42. C. Gunnisoni*

ee. Petals pale yellow.....*42a. C. Gunnisoni* var. *perpulcher*

Section III. CYCLOBOTHRA

a. Flowers erect.

b. Petals conspicuously bearded; glands always circular, slightly depressed, surrounded with a dense ring of hair-like processes..Subsection 9. WEEDIANI

c. Petals obovate, cuneate, little, if any, shorter than the sepals.

d. Petals rarely fimbriate, glabrous at the apex.

e. Petals pinkish or purplish.....*43. C. Plummerae*

ee. Petals pale yellow.....*44b. C. Weedii* var. *peninsularis*

dd. Petals minutely dentate to conspicuously fimbriate, bearded nearly or quite to the apex.

e. Petals orange-yellow.....*44. C. Weedii*
ee. Petals purplish.....*44c. C. Weedii* var. *intermedius*
eee. Petals reddish brown.....*44a. C. Weedii* var. *vestus*
cc. Petals oblong, greatly reduced, half as long as the sepals..*45. C. obispoensis*
bb. Petals inconspicuously bearded; glands, when present, variable in outline, not depressed, not surrounded with a hairy ring, often absent.....
.....Subsection 10. GHIESBREGHTIANI
c. No glands on sepals, those on petals inconspicuous or absent.
d. Flowers white to yellow.
e. Petals yellow; basal leaves about equalling the stems; capsules linear-oblong.....*46. C. venustulus*
ee. Petals white or yellowish; basal leaves exceeding the stems; capsules narrowly lanceolate.....*47. C. exilis*
dd. Flowers brown or brownish.....*48. C. Hintoni*
cc. Glands present and conspicuous on both petals and sepals.....
.....*49. C. Ghiesbreghtii*
aa. Flowers nodding.
b. Petals conspicuously bearded on the inner face.....Subsection 11. BARBATI
c. Flowers yellow, brownish or purplish.
d. Petals obovate, densely bearded to below the gland.....*50. C. barbatus*
dd. Petals narrowly elliptic to spatulate, bearded above the gland only.
.....*51. C. fuscus*
cc. Flowers very dark red or reddish brown.
d. Petals ciliate laterally; flowers apparently reddish brown.....
.....*52. C. Pringlei*
dd. Petals not ciliate; flowers drying black.....*53. C. nigrescens*
bb. Petals very sparingly bearded on the inner face....Subsection 12. PURPUREI
c. Flowers purplish brown; stems moderately leafy.
d. Inner surface of the petals sparsely covered with short hairs.
e. Petals conspicuously ciliate; cauline leaves linear-lanceolate....
.....*54. C. cernuus*
ee. Petals inconspicuously ciliate; cauline leaves lanceolate.....
.....*55. C. purpureus*
dd. Inner surface of the petals glabrous or nearly so; hairs, if present, restricted to midvein and margin.....*56. C. Hartwegi*
cc. Flowers apparently bluish; stems very leafy.....*57. C. foliosus*

Section I. EUCALOCHORTUS

EUCALOCHORTUS Lemaire in Fl. des Serres et Jardins **5**: 430b. 1849, name only; Watson in Proc. Am. Acad. **14**: 262. 1879; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 116. 1901, as section.

Calochortidea Wood in Proc. Acad. Philad. [**20**]: 168. 1868, as section.

Macrodenus Baker in Journ. Linn. Soc. Lond. Bot. **14**: 303. 1874, as subgenus.

Platycarpus Baker, *l. c.* 305, in part, as subgenus.

Bulbs ovoid, with membranaceous coats; stems scapiform or leafy, branched in some species, rarely bulbiferous in the axils of the lower cauline leaves; basal leaves conspicuous, often exceeding the stems; inflorescences subumbellate, the flowers globose to broadly campanulate, erect or nodding; sepals elliptic to lanceolate, acute to acuminate, usually glabrous; petals obovate to lanceolate, cuneate or clawed, usually more or less fringed laterally and bearded above the gland; glands more or less depressed, usually bordered below with an erose to deeply fringed membrane; anthers oblong to lanceolate, obtuse to long-apiculate; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruits orbicular to oblong, 3-winged, erect or nodding; seeds irregular, usually with hexagonally reticulate coats. (Spp. 1–21).

TYPE SPECIES: **Calochortus elegans** Pursh.

The section EUCALOCHORTUS is a very natural group of species which are not closely related to the remaining two sections of *Calochortus*. Morphologically, it is is distinguished by its short, 3-winged capsules, membranaceous bulb-coats, and conspicuous, persistent basal leaves. Cytologically, all species which have been investigated show ten as the basic number of chromosomes, a base number otherwise unknown within the genus.

In contrast to this cytological uniformity, the species of EUCALOCHORTUS show great morphological variation. They may be grouped, however, into four well-marked subsections, which on morphological, cytological and geographical grounds appear to represent four ancient stocks from which have been differentiated the present-day species and species groups.

In comparison with that of the other two sections, the distribution of the section EUCALOCHORTUS is entirely northern. A single species reaches southern California, but the great center of diversity is in the Northwest. From the distributional areas of the various entities, the Klamath Region of northern California and adjacent Oregon seems to present a likely center of dispersal for the entire section.

Subsection 1. PULCHELLI.[24]

Flowers narrowly campanulate to globose, usually nodding; stems leafy, usually branched; ultimate branches and the stems, each terminated by a pair of large, opposite bracts, sub-

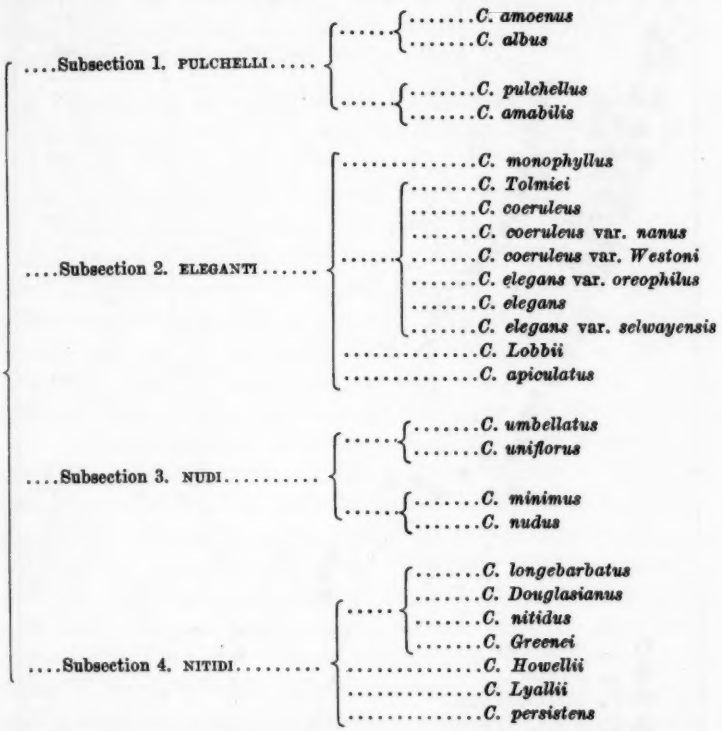
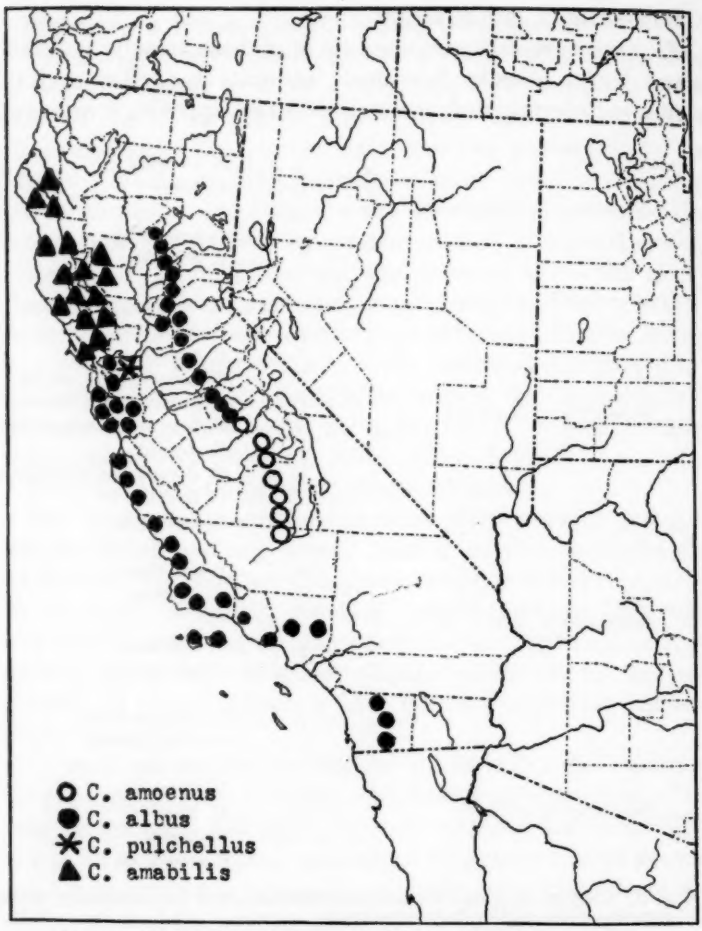


Fig. 1. Diagram showing morphological relationships of the subsections, species and varieties of the section EUCALOCHORTUS.

tending a pair of flowering pedicels; fruits oblong, 3-winged, nodding.

The four species included under this subsection fall into two

[24] PULCHELLI subsect. nov., floribus anguste campanulatis vel globosis plerumque cernuis; caulibus foliatis plerumque ramosis; ramis ultimis et caulibus bracteis duobus magnis oppositis terminatis, bracteis pedicellis duobus florentibus subtendentibus; capsulis oblongis 3-alatis cernis.



Map 1. Distribution of the species of the subsection PULCHELLI.

natural groups. The first of these includes *C. amoenus* and *C. albus,* which are distinguished by their white to purplish flowers and several transverse gland-membranes. The second group is characterized by yellow flowers and the absence of gland-membranes. Here are placed *C. pulchellus* and *C. amabilis.* These distinctions are of fundamental importance, and

it may be that the similarities in branching and flower shape which hold the subsection together are the result of parallel development rather than evidence of phylogenetic relationship.

In distribution, the PULCHELLI are restricted to California, occurring in the Coast Ranges from Humboldt County to San Diego County, and on the western slope of the Sierra Nevada from Butte County to Kern County (Map 1).

1. Calochortus amoenus Greene, Pittonia **2**: 71. 1890.

Calochortus elegans var. *amoenus* Hort. in Gard. Chron. Ser. III. **15**: 810, *fig. 104.* 1894.

Calochortus albus var. *amoenus* Hort. ex Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 219. 1900.

Bulb ovoid, with membranaceous coats; stem slender, erect, more or less flexuous, 2–5 dm. tall, branched, each of the ultimate branches, and the stem, terminated by a pair of large, opposite, lanceolate, acuminate bracts subtending a pair of flowering pedicels; basal leaf 2–5 dm. long, 5–25 mm. broad, tapering toward both ends, usually exceeding the stem; cauline leaves 2 to 5, lanceolate, acuminate, 5–15 cm. long, reduced upward; flowers deep rose, drying purple, narrowly campanulate, erect to reflexed on slender pedicels; sepals shorter than the petals, lanceolate, acute, glabrous; petals elliptic-obovate, obtuse and rounded to acute, sparsely ciliate laterally and sparingly invested on the inner face above the gland with long, slender hairs; gland broad, slightly depressed, traversed by four or five broad, deeply fringed membranes, the lower of which extends entirely across the base of the petal, and is decurrent along the margins, upper membranes successively shorter, fringes of the membranes densely beset with long, slender papillae; anthers oblong, obtuse, about equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse or acute, narrowly 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

Calochortus amoenus is closely related only to *C. albus,* from which it is easily distinguished by the shape and color of the flower and characters of the gland.

DISTRIBUTION. California: western foothills of the Sierra Nevada, from Madera County southward to the Greenhorn Mountains in Kern County.

CALIFORNIA. MADERA CO.: decomposed granite, Coarsegold, 600 m. alt., May 14, 1932, *Benson 3575* (D), *3576* (D, UC); North Fork, 1050 m. alt., May 5, 1913, *Dudley* (D); Coarsegold, May 4, 1938, *Eastwood & Howell 5374* (CA); sandy loam, dense woodland, S. 33, T. 8 S., R. 22 E., 600 m. alt., May 2, 1933, *Hormay H-132* (UC). FRESNO CO.: near Prather, April 19, 1923, *DeGraw* (CA); Base Camp, junction of North and South Forks of Kings River, April 10, 1923, *Duncan 83* (D); Big Sandy Valley, east base of Black Mt., May 17, 1938, *Hoover 3471* (O); Big Sandy Creek, May, 1916, *McDonald* (CA); Samson Flats, June, 1901, *Newhall* (UC); moist, shady, north-facing slope along Grants Park Road, above Dunlap Valley, 690 m. alt., May 11, 1929, *Quibell 1258* (P); Shore Lake Road, above Fall House, 900 m. alt., May 12, 1933, *Winblad* (F). TULARE CO.: 2 mi. below Alder Creek, March 25, 1925, *Abrams 10823* (D, P); at Mr. Sweets' Canyon Ranch on the Mineral King Road, 900 m. alt., April 23, 1925, *Bacigalupi 1206* (D, G, NY, P, UC); on Mineral King Road, 1 mi. below Oak Grove, 750 m. alt., April 22, 1925, *Bacigalupi 1219* (D, P); North Fork of the Tule River, 1 mi. s. of Milo, 6 mi. n. of Springville, 420 m. alt., April 16, 1938, *Constance & Mason 2125* (O); near Milo, April 5, 1900, *Dudley* (CA, D, G, UC); Kaweah, April 27, 1895, *Eastwood* (G); from Lindsay to Springville, May 1, 1927, *Harter* (CA, P); road to Mineral King, about 10 mi. from the General's Highway, May 23, 1933, *Holman* (UC); Kaweah River Basin, May 3, 1901, *Hopping 107* (UC); Deer Creek, 5 mi. n. of California Hot Springs, on road to Porterville, May 16, 1935, *Keck & Stockwell 3331* (D, P, UC); Tule Indian Reservation, May 1, 1920, *Kelley* (CA); Pine Flat, near California Hot Springs, June 19, 1917, *Moxley 557* (UC); near Exeter, April 19, 1923, *Thew* (CA). KERN CO.: hills near Glenville, Greenhorn Range, 960 m. alt., May 15, 1930, *Howell 5121* (CA); hills s. e. of Glenville, Greenhorn Range, 1050 m. alt., May 15, 1930, *Peirson 8876* (UC); Greenhorn Mt., May 31, 1931, *Van Dyke* (CA); below pine belt, Greenhorn Mts., May 20, 1926, *Weston 134* (CA); Greenhorn Mts., near Glenville, April 24, 1927, *Weston 640* (CA).

2. Calochortus albus Douglas ex Bentham in Trans. Hort. Soc. Lond. Ser. II. **1**: 413, *pl. 14, fig. 3*. 1834.

Cyclobothra alba Bentham, *l. c.*

Cyclobothra paniculata Lindley in Bot. Reg. **20**: under *t. 1662*. 1834.

Calochortus albus var. *paniculata* Baker in Journ. Linn. Soc. Lond. Bot. **14**: 304. 1874.

Calochortus albus var. *rubellus* Greene in Erythea **1**: 152. 1893.

Calochortus Englerianus Hort. in Notizblatt Bot. Gart. Mus. Berl. **2**: 318. 1899; Ascherson & Graebner, Syn. Mitteleurop. Fl. **3**: 218. 1905.

Calochortus lanternus Davidson in Bull. So. Calif. Acad. Sci. **23**: 126. 1924.

Bulb ovoid, with membranaceous coats; stem usually stout, erect, 2–8 dm. tall, branched, each of the ultimate branches, and the stem, terminated by a pair (sometimes three) of large, opposite, lanceolate, attenuate bracts subtending an equal number of flowering pedicels; basal leaf 3–7 dm. long, 1–5 cm. broad, tapering toward both ends, usually not exceeding the stem except in short plants; cauline leaves 2–6, lanceolate to linear, attenuate, 5–25 cm. long, reduced upward; flowers white to rose-colored, globose to globose-campanulate at anthesis, nodding on rather slender pedicels; sepals ½ to ⅔ as long as the petals, ovate to lanceolate, acuminate, glabrous; petals elliptic-obovate to elliptic-lanceolate, acute or obtuse, ciliate laterally and moderately invested above the gland with slender, tapering hairs; gland ⅓ to ⅔ the width of the petal, depressed, traversed by four or five (sometimes more) broad, deeply fringed membranes, which become successively shorter upward, fringes of the membranes sparingly papillose; anthers oblong, acute or obtuse, about equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse or acute, 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats and terminal, netted crests.

In a species with a large and discontinuous distribution, it is to be expected that geographical variations of the nature of races or incipient species will be found. This is true, to a certain extent, in *Calochortus albus,* but the morphological differences which are shown by the different races do not seem to justify taxonomic recognition. In general, the Sierran plants of this species, and those from San Diego County, tend to have smaller flowers, which are more nearly campanulate at anthesis, with the gland less deeply depressed, than do the plants of the Coast Ranges. In these characters they somewhat approach *C. amoenus,* but are easily distinguished from that species by the color of the petals and the nature of the gland. In the Coast Range plants there is a tendency for the petals to be flushed with rose. This tendency finds its extreme expression in the variety *rubellus* of Greene, which, because of the

numerous intermediates, cannot be maintained as taxonomically distinct.

DISTRIBUTION. California: western foothills of the Sierra Nevada from Butte County southward to Madera County, and in the Coast Ranges from the vicinity of San Francisco Bay southward to the San Gabriel and Santa Monica mountains of Los Angeles County; also in the Cuyamaca Mountains in the interior of San Diego County and on Santa Cruz and Santa Rosa islands.

CALIFORNIA. BUTTE CO.: Butte Creek, June, 1896, *Austin 30* (M, UC); near Clear Creek, 55 m. alt., April 15–30, 1897, *Brown 190* (D, F, M, NY, PA, RM); Butte Creek, May, 1897, *Bruce 2118* (P); Butte Creek, May, 1898, *Bruce 2119* (NY); Midas Mine, near Enterprise, South Fork of the Feather River, 390 m. alt., May 22, 1937, *Hedges* (UC); plateau above Clear Creek, on the Paradise Road, May 8, 1914, *Heller 11375* (CA, Clokey, D, F, G, M, NY, PA, UC); Berry Canyon, near Clear Creek, May 7, 1902, *Heller & Brown 5484* (D, F, G, M, NY, P, PA, RM); Durham, May 30, 1932, *Morrison* (P); Durham, June 5, 1932, *Morrison* (CA); Oroville, *Purdy* (G); near Magalia, May 5, 1918, *Van Eseltine 1741* (G, NY). YUBA CO.: Los Vergils, May 22, 1921, *Eastwood 10558* (CA, RM). NEVADA CO.: Bear River, 390 m. alt., June 6, 1916, *Hall 10151* (D, G, UC); 22 mi. e. of Marysville, May 11, 1911, *Jones 50* (G). PLACER CO.: foothills, North American River, *Bolander 4530* (G); near Auburn, on road to Grass Valley, May 8, 1937, *Eastwood & Howell 4336* (CA); between Auburn and Newcastle, May 17, 1891, *Sonne 7* (UC); near Auburn, 1892, *Sonne* (RM). ELDORADO CO.: Simpson's Ranch, Sweetwater Creek, May 18, 1907, *Brandegee* (NY, UC); 3 mi. s. of Coloma, 480 m. alt., April 30, 1938, *Constance & Morrison 2170* (O, WS); Placerville, May, 1918, *Hannibal* (D); Placerville, May, 1923, *King* (CA); Marshall Monument, Coloma, April 14, 1928, *Peers* (CA); rather shady hill-slope, near Placerville, May 21, 1917, *Ramaley 11300* (UC); Nashville, April 29, 1900, *Rixford* (RM); Coloma, May 16, 1928, *Vortriede* (CA). SACRAMENTO CO.: rocky places near American River, near Folsom, April 22, 1928, *Copeland 173* (P); Folsom, April 26, 1938, *Copeland* (O). AMADOR CO.: Agricultural Station, 600 m. alt., May, 1891, *Hansen 46* (D); same locality, May, 1893, *Hansen 46* (M); New York Falls, 450 m., alt., May 25, 1893, *Hansen 46* (P); Caminetti Ranch, near Jackson, 480 m. alt., June 1–20, 1904, *Mulliken 102* (D, P, RM, UC); Sutter Creek, May 10, 1918, *Wood* (D). CALAVERAS CO.: Altaville, May 19, 1927, *Becker* (CA); Mokelumne Hill, *Blaisdell* (CA, Clokey); Murphys, May 17, 1887, *Smith* (PA); meadows and moist hillsides, near limestone quarry, Calaveras Cement Works, near San Andreas, 150 m. alt., May 7, 1927, *Stanford 262* (P); Fourth Crossing, between Valley Spring and San Andreas, May 21, 1923, *Steinbeck* (CA). TUOLUMNE CO.: Jamestown, May, 1900, *Bioletti* (UC, UO); shaded slopes, Spring Gulch, near Bear Creek, 300 m. alt., May 2, 1919, *Williamson 22* (Clokey), *28* (CA, D, NY, P). MARIPOSA CO.: Mariposa, May 10, 1893, *Congdon* (D); Cathey Valley, April 19, 1915, *Eastwood 4338* (CA); foothills near Mariposa, May 5, 1933, *Nelson & Nelson 527* (D, M, RM); above Coulterville, May, 1932, *Seale* (CA, D, P). MADERA CO.: Coarsegold, 450 m. alt., May 14, 1932, *Benson 3591* (D, UC). CONTRA COSTA CO.: s. e. of Mt. Diablo, May 24, 1862, *Brewer 1157* (UC). ALAMEDA CO.: Lake Chabot, San Leandro, May 6, 1900, *Carruth* (CA); Niles Canyon, May 1, 1891, *Chesnut & Drew* (UC). SAN MATEO CO.: Woodside, May, 1901, *Abrams 1571* (D); Page Mill Creek, above Stanford University, April 8, 1895, *Applegate 727*

(D); San Francisquito Creek, near and above Stanford University, May 8, 1895, *Applegate 727a* (D); near Burlingame, May, 1904, *Baker* (UC); San Mateo, June 23, 1893, *Blasdale* (UC); side of hill near San Mateo Ravine, April 21, 1894, *Dudley* (D); San Mateo, May, 1903, *Elmer 4846* (CA, D, M, NY, P, UC, UO, WS); above Woodside, on La Honda Road, east slope of Santa Cruz Mts., May 13, 1932, *Keck 1778* (UCLA, UM); San Bruno, June 10, 1868, *Kellogg & Harford 991* (CA, G, M, NY); shady slope, Jasper Ridge, May, 1907, *McGregor* (M); Redwood Grove in Portola Valley, June 8, 1907, *Randall 219* (D); shady canyons, 9 mi. w. of Stanford University, June 11, 1935, *Rose 35214* (F, M, NY); Crystal Springs, June, July, *Schmidt* (UC); Woodside, June 9, 1919, *Walther* (CA, M); Woodside, May 9, 1920, *Walther* (CA). SANTA CLARA CO.: Stanford University, April, 1900, *Atkinson* (D); foothills near Stanford University, April 14, 1902, *Baker 622* (P); hill above Palo Alto Stock Farm, April 24, 1895, *Burnham* (P); near Stock Farm, Stanford University, May, 1895, *Dudley* (D); along Coyote Creek, May 31, 1895, *Dudley 4143* (D); near Stanford University, April 28, 1902, *Dudley* (P); foothills w. of Los Gatos, May 7, 1904, *Heller 7395* (D, F, G, M, NY, PA, RM, UC); back of Alum Rock Park, April 27, 1907, *Heller 8476* (D, F, G, M, NY, PA); between Alma and Los Gatos, May 9, 1920, *Hichborn* (M); Coyote Creek, 3 mi. e. of Madrone, May 20, 1937, *Howell 12989* (CA, NY); Los Gatos, April 16, 1888, *Leeds* (F); along San Francisquito Creek, near St. Michaels Church, May 13, 1894, *Leithold* (D); foothills, Stanford University, April 22, 1896, *Leithold* (D); Alum Rock Spring, near San Jose, May, *Lemmon* (F, M, UC); Permanente Creek, April 21, 1907, *Mason 124* (F); Raymond's Ranch, Los Gatos, 420 m. alt., June 20, 1914, *Newell* (CA); Smith Creek, 645 m. alt., May 30, 1907, *Pendleton 797* (UC); eastern side of Mt. Hamilton, 1140 m. alt., May 7, 1934, *Sharsmith 1049* (O); heavily wooded, northeastern slope of Seeboy Ridge, Mt. Hamilton Range, 675 m. alt., May 26, 1935, *Sharsmith 3216* (WS); Olson Ranch, Loma Prieta, June 7, 1902, *Thompson* (D). SANTA CRUZ CO.: Santa Cruz, May 27, 1929, *Canby 239* (P); Glenwood, 1914, *Davis* (CA, G, M); Flat Rock Camp, Big Basin, June 5, 1897, *Dudley* (D); Santa Cruz, June 28, 1881, *Jones* (P); railroad near Big Trees, April 5, 1914, *Stinchfield 147* (D). MONTEREY CO.: between Posts and Rancho los Pesares, May 14, 1920, *Abrams 7466* (D, P); Tularcitos Ranch, Carmel Valley, May 15, 1924, *Bacigalupi* (D); burro trail, eastward slope, Santa Lucia Mts., June 9, 10, 1909, *Brandegee* (G, M, NY, RM, UC); Guadalupe Ranch, Palo Escrito Hills, May 11, 1861, *Brewer 592* (CA, G, M, UC, WS); sandy loam, Pajaro Hills, June, July, 1899, *Chandler 376* (UC); "Nova California" (locality uncertain, but probably near Monterey), 1833, *Douglas* (G, Kew TYPE, NY); gorge of San Antonio Creek, near Jolon, May 13, 1895, *Dudley* (D); Cypress Point, Monterey, May 28, 1912, *Eastwood 93* (CA, Clokey, G); Tassajara Hot Springs, June, 1901, *Elmer 3222* (D, M, UO); Carmel Highlands, 200 m. alt., June 21, 1925, *Epling 8382* (M, UCLA); Santa Lucia Mts., near Lucia, June 9, 1915, *Hall 10001* (UC); Monterey, *Hartweg 1984* (NY); pine woods, Pacific Grove, May 14, 1903, *Heller 6728* (D, F, G, M, NY, P, PA, RM, UC, UO); shaded grassy places in the pine forest at Pacific Grove, June 25, 1927, *Heller 14398* (F, M, PA); Rancho del Monte, Carmel River, May 7, 1921, *Mason* (D); Palo Colorado Canyon, near Big Sur, June 21, 1921, *Parish 20038* (G); Pacific Grove, June 12, 1907, *Patterson & Wiltz* (D, UC); Cypress Point, near Pacific Grove, June 21, 1907, *Patterson & Wiltz* (D); Santa Lucia Mts., May, 1898, *Plaskett 139* (NY, RM); between Point Lobos and Ocean Home, Carmel-

by-the-Sea, April 17, 1910, *Randall* (D); between 17-Mile Drive and Carmel-by-the-Sea, April 30, 1910, *Randall 420* (D); Carmel-by-the-Sea, May 3, 1910, *Randall 444* (D); near Pacific Grove, June 9, 1901, *Setchell* (UC); 17-Mile Drive, about 4 mi. n. w. of Carmel, June 26, 1937, *Youngberg 193* (P). SAN LUIS OBISPO CO.: Santa Lucia Mts., May 1, 1900, *Barber* (UC); Cambria, May, 1908, *Cobb 76* (D, F, G, M, NY, P, PA, RM, UC, UO); Pettit Canyon, San Luis Obispo, June 4, 1910, *Condit* (UC); Cambria Road, Santa Rosa Creek, June 13, 1911, *Condit* (UC); Cambria, April 28, 1926, *Eastwood 13582* (CA); Cambria, June 14, 1938, *Eastwood & Howell 5946* (CA); Arroyo Grande, May, 1895, *King* (UC); San Simeon, near Cayucos, May, 1923, *McKenzie* (CA); Santa Lucia Mts., May, 1885, *Summers* (PA, UC). SANTA BARBARA CO.: Santa Inez Mts., near Santa Barbara, 1888, *Brandegee* (D, UC); Adelaide District, near Lompoc, June 20, 1930, *Sinsheimer* (CA); on north slope in chaparral, s. of Buelton, 2 mi. n. of Las Cruces, May 10, 1926, *Wiggins 2094* (D). SANTA CRUZ ISLAND: without exact locality, April, 1888, *Brandegee* (D, UC); wooded slope, Dix Canyon, 100 m. alt., May 26, 1930, *Clokey 4882* (Clokey, NY, P, UC); wooded hillside, Pelican Bay, 75 m. alt., May 23, 1930, *Clokey 4883* (Clokey, F, M, NY); grassy hillside, Friars Canyon, 30 m. alt., April 18, 1931, *Clokey 5168* (Clokey, NY); ravine w. of Pelican Bay, 40 m. alt., April 20, 1931, *Clokey 5169* (Clokey, G, NY, RM, UM, WS); ridge w. of Marine Garden, 90 m. alt., May 25, 1930, *Clokey 7481* (Clokey); without exact locality, May 12–15, 1929, *Ellison* (UCLA); near Pelican Harbor, June 14, 1930, *Hoffmann* (D, P); without exact locality, May 24, 1918, *Miller* (CA, Clokey). SANTA ROSA ISLAND: without exact locality, June, 1888, *Brandegee* (UC); without exact locality, May 15, 1932, *Dunn* (UCLA); without exact locality, April 15, 1935, *Sweet* (P). VENTURA CO.: Foster Park, April 14, 1916, *Eastwood 4975* (CA); Casitas Pass, 180 m. alt., May, 1902, *Hall 3213* (UC). LOS ANGELES CO.: Little Santa Anita Canyon, San Gabriel Mts., July 1, 1902, *Abrams 2620* (D, G, M, NY, P, PA); shaded side of ravine, Fulkerson's Ranch, Claremont, 720 m. alt., May 24, 1897, *Chandler* (UC); open slope, San Dimas Canyon, May 9, 1935, *Clokey & Anderson 6544* (Clokey); Los Alisos Canyon, Santa Monica Mts., April 18, 1931, *Epling* (UCLA); Eaton Canyon, near Pasadena, 450 m. alt., June 2, 1907, *Grinnell* (F); Topanga Canyon, Santa Monica Mts., May 17, 1933, *Hilend & Reis* (UCLA); San Dimas Canyon, San Gabriel Mts., May 10, 1928, *Hitchcock* (P); at the end of the public road, West Fork of San Dimas Canyon, San Gabriel Mts., May 9, 1931, *Mathias 857* (M); Claremont, June 1, 1909, *Metz 53* (P); damp, shaded slope, Topanga Canyon, Santa Monica Mts., 90 m. alt., May 17, 1920, *Munz & Harwood 3977* (P, RM); hillside, Malibu Road, Santa Monica Mts., May 11, 1935, *Purer 6577* (M); Johnson's pastures, near Claremont, April 29, 1916, *Robinson* (P); mouth of Live Oak Canyon, near Claremont, May 3, 1916, *Robinson* (P); Malibu Ranch, May, 1926, *Scott* (UCLA); Palmers Canyon, Claremont, May 3, 1901, *Williams 14* (P). SAN DIEGO CO.: Middle Peak, Cuyamaca Mts., June 24, 1903, *Abrams 3861* (D, G, M, NY, P, PA); Cuyamacas, July, 1932, *Clayton 83* (UC); Cuyamaca, June 25, 1919, *Eastwood 9137* (CA); Palomar Mt., June 24, 1932, *Epling, Darsie, Knox & Robison 1078* (UCLA); Cuyamaca Mts., 1200 m. alt., May, 1899, *Hall* (UC); near the Hutcut, Palomar, 900 m. alt., May 17–June 1, 1901, *Hall 1937* (UC); Cuyamaca Lake, May 30, 1926, *Jones* (D, P); Cuyamaca Lake, June 11, 1932, *Jones* (UC); burn in chaparral, Potrero Grade, May 10, 1924, *Munz 8055* (P); shaded north slope, Cuyamaca Lake, 1380 m. alt., June 27, 1923, *Munz & Harwood 7233* (NY, P);

Cuyamaca Mts., July 12, 1875, *Palmer 376* (F, M); Stonewall Mine, Cuyamaca Mts., 1380 m. alt., June 5–7, 1897, *Parish 4422* (F, G, M, NY); Julian Canyon, June, 1880, *Parish & Parish 357* (D, F); hillside, Palomar, June 6, 1937, *Purer 7269* (M); in open woods, Pine Hills, May 28, 1917, *Spencer 494* (G, NY, P); Talley's Ranch, 1800 m. alt., July, 1895, *Stokes* (D); Julian, June, 1880, *Vasey 632* (PA).

3. Calochortus pulchellus Douglas ex Bentham in Trans. Hort. Soc. Lond. Ser. II. 1: 412, *pl. 14, fig. 1.* 1834.

Cyclobothra pulchella Bentham, *l. c.*

Bulb ovoid, with membranaceous coats; stem usually stout, erect, 1–3 dm. tall, often branched, each of the ultimate branches, and the stem, terminated by a pair of large, opposite, lanceolate, attenuate bracts subtending a pair of flowering pedicels; basal leaf 1–4 dm. long, 1–3 cm. broad, tapering toward both ends, often exceeding the stem; cauline leaves 2 or 3, lanceolate to linear, attenuate, 5–25 cm. long, reduced upward; flowers lemon-yellow, globose, nodding on rather slender pedicels; sepals slightly shorter than the petals, ovate to lanceolate, acuminate, glabrous; petals lanceolate, obtuse, clawed, conspicuously fringed with rather short, thick hairs, inner face sparsely invested to the tip above the claw with similar hairs; gland deeply depressed, bounded above with a narrow, transverse band of long, slender processes, which are more or less coalescent and directed downward, covering the upper portion of the claw; anthers oblong, obtuse or acute, shorter than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse, broadly 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

This species is closely related to *C. amabilis,* but can be distinguished by its larger, more nearly globose flowers, which are of a lighter shade of yellow, and its longer-fringed petals, which are sparsely hairy to the tip.

DISTRIBUTION. California: endemic in the Mount Diablo Region, Contra Costa County. Similar plants from the North Coast Ranges belong to the closely related, but distinct, *C. amabilis.*

CALIFORNIA. CONTRA COSTA CO.: at spring, 4½ mi. from summit, Mt. Diablo, May 25, 1921, *Abrams 8053* (D); among digger pines, near farm house, in branch of Pine Canyon, Mt. Diablo, May 2, 1914, *Brandt* (UC); north slope of Mt. Diablo, May 7, 1862, *Brewer 1063* (G, UC); near Mt. Diablo,

May 26, 1862, *Brewer 1163* (UC); Lafayette, April, 1900, *Carruth* (CA); open fields, near the base of Mt. Diablo, April 8, 1931, *Constance 173* (PA); locality not known, but presumably from near Mt. Diablo, the only place the species has since been found, "Nova California," 1833, *Douglas* (G, Kew TYPE, NY); Mt. Diablo, May 30, 1914, *Eastwood 4442* (CA); Mt. Diablo, May 4, 1923, *Eastwood 11728* (CA); Mt. Diablo, June, 1903, *Elmer 4631* (CA, D, M, NY, P, UC, UO, WS); north slopes, near Pine Canyon, Mt. Diablo, 360 m. alt., May 30, 1916, *Hall 10132* (D, G, P, UC); between Port Costa and Martinez, 18 m. alt., June 5, 1928, *Hitchcock 14* (P); Marsh Creek Canyon, May 4, 1938, *Hoover 3339* (O); Mt. Diablo, April 28, 1868, *Kellogg & Harford 990* (G, NY); Mt. Diablo, May 18, 1913, *Manor* (CA, Clokey, G, NY); Mt. Diablo, May 15, 1899, *Purdy* (D, G, M, NY, RM, UC, UCLA, UO).

4. Calochortus amabilis Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 119. 1901.

Calochortus pulchellus var. *amabilis* Jepson, Fl. W. Mid. Calif., p. 113. 1901.

Calochortus pulchellus var. *maculosus* Watson ex Purdy in Zoe **1**: 245. 1890.

Bulb ovoid, with membranaceous coats; stem usually stout, erect, 1–3 dm. tall, usually branched, each of the ultimate branches, and the stem, terminated by a pair of large, opposite, lanceolate, attenuate bracts subtending a pair of flowering pedicels; basal leaf 2–5 dm. long, 0.5–4 cm. broad, tapering toward both ends, exceeding the stem; cauline leaves 2 to 4, lanceolate to linear, attenuate, 2–20 cm. long, reduced upward; flowers deep yellow, often tinged with brown, globose to globose-campanulate, nodding on rather slender pedicels; sepals equalling to somewhat exceeding the petals, ovate to lanceolate, acute to acuminate, glabrous; petals lanceolate, obtuse, clawed, conspicuously fringed with short, thick hairs, inner face naked, or sometimes with a few short hairs near the gland; gland deeply depressed, bounded above with a narrow, transverse band of long, slender processes, which are more or less coalescent and directed downward, covering the upper portion of the claw; anthers oblong, obtuse or acute, shorter than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse or acute, 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

This species is closely related to, and has been frequently

confused with, *C. pulchellus*, but differs from that species in its smaller, deeper yellow flowers and its shorter-fringed, nearly naked petals. These characters are remarkably uniform, and, although intermediates occur, these are very rare and appear to represent only an occasional extreme plant within a perfectly normal population.

DISTRIBUTION. California: brushy slopes in the North Coast Ranges, from Humboldt County southward to Solano and Marin counties.

CALIFORNIA. HUMBOLDT CO.: between Blocksberg and Bridgeville, July 11, 1916, *Abrams 5980* (D, NY); roadside n. of Redway, May 25, 1934, *Armstrong* (UC); dry bank above Dyerville-Bull Creek Flat Road, ½ mi. w. of Dyerville, Humboldt Redwood Park, 50 m. alt., June 1, 1934, *Constance 769* (WS); by South Fork of Eel River, s. of Dyerville, June 20, 1899, *Dudley* (D); Carlotta, June, 1915, *Hawver* (CA); Sylvandale, 8 mi. n. of Garberville, May 2, 1931, *Jussel* (CA); Miranda, on South Fork of Eel River, May 16, 1926, *Kildale 2004* (D); Fort Seward, 120 m. alt., May 14, 1914, *Tracy 4422* (UC). MENDOCINO CO.: Santa Rosa Creek, Ukiah, April 24, 1864, *Bolander 3829* (CA, F, G, M, UC, WS); Willitts, June, 1906, *Clark* (CA); Ukiah, June 13, 1913, *Eastwood 3286* (CA, Clokey); Ukiah, May, 1915, *Eastwood* (CA); Potter Valley, May 20, 1925, *Eastwood 12746* (CA); Lost Creek, May 29, 1937, *Eastwood & Howell 4388* (CA); open, grassy north slopes, North Coast Ranges, near the headwaters of Big River, 600 m. alt., June 1, 1919, *Hall 10923* (CA, D, F, G, M, NY, P, RM, UC, UCLA, UO); near Orrs Hot Springs, May 23, 1921, *Head* (CA); near Fort Bragg, May 25, 1921, *Head* (CA); Willitts, May 21, 1921, *Piper* (CA, WS); near Ukiah, *Purdy* (F, G, UC); stony slopes, Potter Valley, 300 m. alt., May, 1894, *Purpus 871* (UC). GLENN CO.: in brush along Dry Creek, near Stonyford, April 23, 1926, *Ferris 6465* (D, NY, P). COLUSA CO.: Grapevine Grade, between Stonyford and Sites, April 23, 1926, *Ferris 6447* (D). LAKE CO.: near Bartlett Springs, May 6, 1928, *Abrams 12488* (D); Houghs Springs, May 7, 1928, *Abrams 12521* (D); dry brushy hillside, Pine Grove, n. of Cobb Mt., March 31, 1934, *Applegate 8875* (D); Lower Lake, June 3, 1917, *Bentley* (D); chamise thickets, Mt. Konocti, May 4, 1925, *Blankinship* (CA); same locality, May 10, 1929, *Blankinship* (M); Lower Lake, May 9, 1902, *Bowman* (D); 2 mi. n. e. of Middletown, North Coast Ranges, 300 m. alt., April 22, 1938, *Constance 2138* (O, WS); Dashiells, Mt. Sanhedrin, May 22, 1925, *Eastwood 12789* (CA); in gravel among the chaparral, Coast Range, north side of the ridge west of Leesville, 450 m. alt., May 10, 1919, *Heller 13151* (CA, D, G, M, NY); moist oak woods near rill-bed, near Lakeport, May 22, 1933, *Henderson 15438* (UO); Jordan Park, Cobb Mt., April 30, 1933, *Jussel* (CA); between Cobb Mt. and Adams Springs, on the Binkley Ranch, June 26, 1933, *Jussel 191* (CA, UC); 3 mi. e. of Bartlett Springs, May 7, 1928, *Kildale 4940* (D); on low hills with open chaparral, 3.3 mi. n. of Middletown, April 3, 1926, *Peirson 6619* (P); foot of Mt. Sanhedrin, June, 1917, *Reynolds* (CA); 1½ mi. s. w. of Lakeport, 450 m. alt., May 19, 1937, *Wilson 395* (UC). NAPA CO.: St. Helena Grade, May 3, 1928, *Abrams 12208* (D); 4 mi. s. of Middletown, May 4, 1928, *Abrams 12287* (D); hills, 1 mi. n. of Napa Soda Springs, April 26, 1925, *Bacigalupi 1226* (D); Howell Mt., 6 mi. n. e. of Pacific Union College, on road to Aetna Springs, June 2, 1933, *Bacigalupi, Ferris & Wiggins 6667* (D,

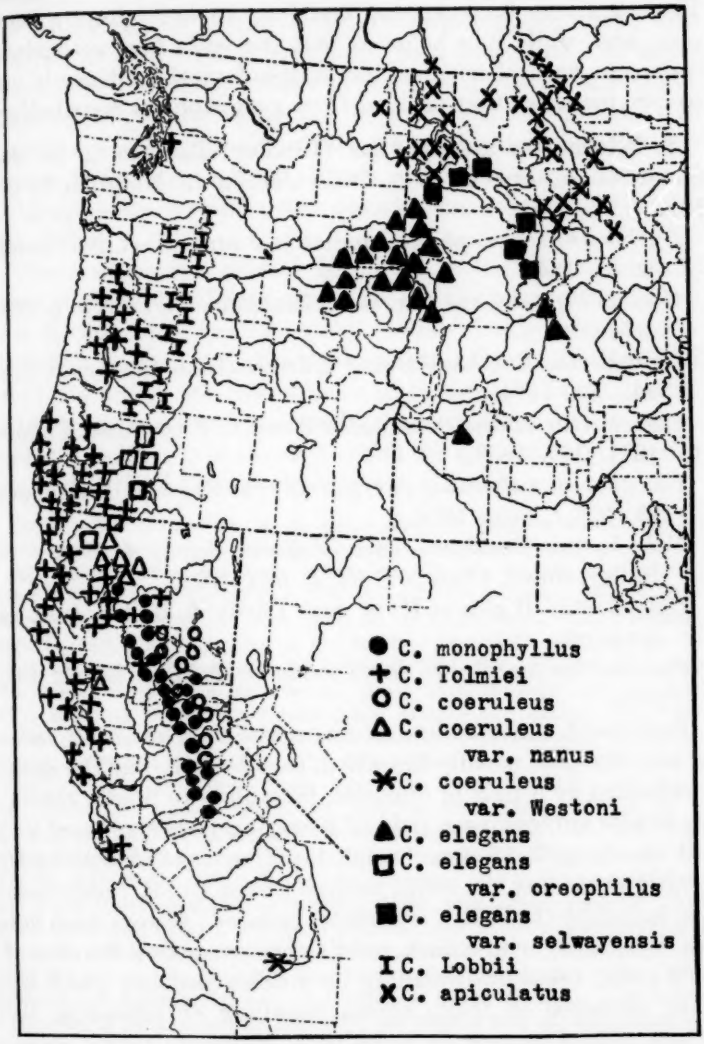
UC); Mt. St. Helena, April 20, 1903, *Baker 2622* (G, M, NY, P); Pope Valley Grade from Calistoga, June 1, 1909, *Brandegee* (UC); Calistoga Road, 1 mi. below Patten's, March 21, 1926, *Howell 1730* (CA); Wooden Valley Grade, 5 mi. e. of Napa, April 2, 1931, *Howell 6076* (CA); in rich loam among rocks on burn, Wooden Valley Grade, west side of Napa Range, 5 mi. n. e. of Napa, 170 m. alt., April 2, 1931, *Keck 1019* (D, G, M, P, PA); in chaparral, north side of Howell Mt., 1 mi. above Pope Valley P. O., May 28, 1933, *Keck 2330* (D, P); rocky hillsides in partial shade, head of Moores Creek, 3–4 mi. e. of Angwin's, Howell Mt., 360 m. alt., May 15, 1902, *Tracy 1480* (P, UC); 2 mi. s. of Hawkins Mount Inn Camp, May 3, 1928, *Wolf 1787* (D). SONOMA CO.: Santa Rosa Creek Canyon, April 23, 1898, *Baker 29* (UC); Stewarts Canyon, May, 1899, *Baker* (UC); Anderson Valley, April, May, 1866, *Bolander 6249* (CA, M, UC, WS); near Sea View, June, 1901, *Carruth* (CA); St. Helena to Santa Rosa, April 27, 1907, *Chandler 7541* (UC); Trosper's, Cazadero, May 20, 1925, *Graff* (CA, P); Skaggs Springs, June 3, 1915, *Hawver* (CA, Clokey); between Santa Rosa and Agua Caliente, April 22, 1902, *Heller & Brown 5339* (D, F, G, M, NY, PA); Cloverdale, April 25, 1924, *Jones* (P); mountains west of Calistoga, May, 1894, *Kraus* (D); mountains near Franze Valley, May 6, 1895, *Kraus* (D); edge of wooded slope in grassland, near Mark West Springs, June 2, 1929, *Mexia 2393* (RM, UC); Los Guilicos, May, 1893, *Michener & Bioletti* (F, G, M, NY, P, UC, WS); Kenwood, May 14, 1933, *Nelson & Nelson 557* (D, M, RM); in oak woods at edge of valley, Alexander Valley, May 9, 1930, *Parks & Parks 605* (D, F, G, M, NY, P, RM, UC, UCLA, UO); Christopher Ranch, 2 mi. from Cazadero, 300 m. alt., June 11, 1930, *Randall* (UC); Cazadero, April 25, 1918, *Wood* (D, M). MARIN CO.: Corte Madera, April 28, 1904, *Heller 7364* (D, F, G, M, NY, PA, RM, UC); Corte Madera Ridge, near Tank, May, 1930, *Jackson* (CA). SOLANO CO.: Mix (Weldon) Canyon, April 23, 1938, *Hoover 3186* (O).

Subsection 2. ELEGANTI.[25]

Flowers broadly campanulate, erect or spreading; petals usually conspicuously fringed and densely bearded, clawed; stems usually scapiform, branched normally in only two species; fruits elliptic to oblong, 3-winged, nodding.

The six species and four varieties included under this subsection are morphologically quite uniform and probably closely related. Three of the species are very distinct. *C. monophyllus* differs from all other members of the subsection in its yellow flowers. In this character and others, it appears to be genetically related to *C. amabilis* and *C. pulchellus* of the preceding subsection. *C. apiculatus* and *C. Lobbii* also stand alone, the former by reason of its dark, nearly circular gland, and the

[25] ELEGANTI subsect. nov., floribus late campanulatis erectis aut patentibus; petalis plerumque insigniter fimbriatis dense barbatis unguiculatis; caulibus plerumque scapiformibus, in duobus speciebus solis normaliter ramosis; capsulis ellipticis vel oblongis 3-alatis cernuis.



Map 2. Distribution of the species and varieties of the subsection ELEGANTI.

latter on the dark, glandular spot near the base of each sepal. The remaining three species and four varieties form a complex, and, while it is believed that the units here recognized represent natural entities, the morphological evidence is not so convincing as that derived from geographical distribution.

5. Calochortus monophyllus (Lindley) Lemaire in Fl. des Serres et Jardins **5**: 430b. 1849; Jepson in Madroño **1**: 61. 1917.

Cyclobothra monophylla Lindley in Journ. Hort. Soc. Lond. **4**: 81. 1849.

Cyclobothra elegans var. *lutea* Bentham, Pl. Hartw. p. 338. 1857.

Calochortus Benthami Baker in Journ. Linn. Soc. Lond. Bot. **14**: 304. 1874.

Calochortus nitidus β. *cornutus* Wood in Proc. Acad. Philad. [**20**]: 169. 1868.

Calochortus pulchellus var. *parviflorus* Regel in Gartenflora **23**: 226, *t. 802a.* 1874.

Calochortus Benthami var. *Wallacei* Purdy & Bailey in Bailey, Stand. Cyclop. Hort. **2**: 633. 1914.

Calochortus Wallacei Hort. acc. Purdy & Bailey, *l. c.*, as synonym.

Calochortus maculatus Eastwood in Leafl. West. Bot. **1**: 133. 1934.

Bulb ovoid, with membranaceous coats; stem low, erect, more or less flexuous, usually branched, each branch, and the stem, terminated by a pair of opposite, lanceolate to linear, attenuate bracts subtending a pair of flowering pedicels; basal leaf 1–3 dm. long, 3–15 mm. broad, tapering toward both ends, greatly exceeding the stem; cauline leaves 1 to 3, rarely lacking, lanceolate to linear, attenuate, reduced; flowers deep yellow, frequently with a dark, reddish brown spot on the claw of each petal, erect or spreading on slender pedicels which become recurved in fruit; sepals equalling or exceeding the petals, oblong-lanceolate, acuminate, glabrous; petals oblanceolate, acute or obtuse, clawed, fringed and densely bearded above the gland with short, thick clavate hairs; gland trans-

verse, arched upward, surface depressed, naked, bordered below with a narrow, deeply fringed membrane, and above with a series of short, thick processes, both processes and membrane-fringe densely short-papillose; anthers lanceolate, short-apiculate, equalling the broadly winged filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, obtuse or acute, 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

Calochortus monophyllus is placed in the subsection ELEGANTI because of its flower shape and the character of the gland. It is distinguished from all other species of this subsection by its yellow flowers and characteristic branching. In these and other characters, its resemblance to *C. amabilis* is so striking as to suggest genetic relationship,[26] and perhaps it may represent an ancestral type through which the subsection PULCHELLI has been derived from the subsection ELEGANTI.

DISTRIBUTION. California: in the yellow pine belt, western foothills of the Sierra Nevada, from Shasta County southward to Tuolumne County.

CALIFORNIA. SHASTA CO.: rocky hillside, near Morleys Station, May 9, 1896, *Baker 39* (UC); Reed Road, May 1, 1900, *Baker* (UC); Whitmore, May 11, 1923, *Bethel* (CA); Montgomery Creek, June 27, 1912, *Eastwood* (CA); Redding, April 24, 1934, *Rose* (CA, type of *C. maculatus* Eastwood). TEHAMA CO.: 18 mi. w. of Mineral on Susanville Road, May 9, 1930, *Gillespie 9298* (D); near Pine Creek, "in montibus Sacramento," April, 1847, *Hartweg 1932* (G, Kew, NY); Red Bluff, June, 1917, *Wickes* (CA). PLUMAS CO.: Salmon Lake, 1919, *Kelley* (CA). BUTTE CO.: Little Chico Creek, May, 1883, *Austin 14* (P); same locality, April, 1896, *Austin* (M, UC); Little Chico Canyon, May, 1896, *Austin 25* (NY); Little Chico Butte Creek, May, 1897, *Bruce 2116* (P); near Paradise, lower Sierra Nevada, 600 m. alt., April 12, 1915, *Clark 213* (CA, D, F, G, M, NY, P, RM, UC, UCLA, UO); Brush Creek, 1907, *Conger* (P, RM, UC); Midas Mine, near Enterprise, South Fork of the Feather River, 390 m. alt., May 22, 1937, *Hedges* (UC); in the blue oak-digger pine belt, on grassy banks near Butte Creek, Chico-Centerville Road, 8 mi. from Chico, April 16, 1914, *Heller 11295* (CA, D, F, G, NY, UC); Durham, April 10, 1932, *Morrison* (CA); Chico, May, 1883, *Parry 260* (F, M); Chico, *Purdy* (UC); Honcut, April 12, 1931, *Rose* (CA); near De Sabla, May 5, 1918, *Van Eseltine 1739, 1740* (NY). SIERRA CO.: Downieville, April 15, 1928, *Vortriede* (CA). YUBA CO.: near Indian Valley, May 2, 1934, *Applegate 8891* (D); Los Vergils, May 22, 1921, *Eastwood*

[26] **Calochortus Goldyi** Watkins ex Purdy & Bailey in Bailey, Stand. Cyclop. Hort. **2**: 632. 1914, is said to be possibly a garden hybrid between *C. amabilis* and *C. monophyllus (Benthami)*. Hybrids between *C. monophyllus* and *C. albus* occur in nature, but are rare.

10578 (CA); Camptonville District, Tahoe National Forest, May, 1931, *Smith* (UC). NEVADA CO.: red clay soil, in oak hills, 5 mi. below Grass Valley, Auburn Highway, April 22, 1928, *Applegate 5359* (D); rocky soil by Baltic Trail, June 14, 1893, *Dudley* (D, NY); Nevada City, June 20–22, 1912, April 8, 1918, *Eastwood* (CA); 12 mi. s. of Grass Valley, May 8, 1937, *Eastwood & Howell 4345* (CA); "Bear Valley, montium Sacramento," June, 1847, *Hartweg 1987* (G, NY); in red clay soil, in the yellow pine belt, near Grass Valley, May 25, 1919, *Heller 13204* (CA, D, F, G, M, NY, PA); Rough and Ready, April 13, 1892, *Jepson* (UC); 5 mi. n. of Colfax, 2 mi. w. of Chicago Park, April 10, 1916, *Rolph* (UC). PLACER CO.: near river, Auburn, April 20, 1919, *Bentley* (D); dry soil under *Arctostaphylos* on burned east slope, east edge of Applegate, Sierra Nevada foothills, 600 m. alt., April 30, 1938, *Constance & Morrison 2172* (M, O, WS); Gold Run, April 26, 1923, *Mitchell* (CA); Dutch Flat, April, 1921, *Patterson* (D); under pines, Colfax, May 17, 1891, *Sonne* (M, UC); near Auburn, 1892, *Sonne* (RM); Towles Station, May, 1896, *Sonne* (NY). ELDORADO CO.: open forest n. of Camino, April 13, 1924, *Benson 19* (D); Camino, 7 mi. above Placerville, May 22, 1907, *Brandegee* (UC); near Kelsey, March 26, 1927, *Eastwood 14197* (CA); hillsides, May 22, 1903, *Gross 13* (D); Kelsey, April 21, 1883, *Jones* (CA, Clokey, M, NY, P); Placerville, May, 1923, *King* (CA); 10 mi. e. of Placerville, May 20, 1917, *Ramaley 11292* (UC); above Placerville, April 29, 1928, *Robbins* (P); Placerville Hills, April 21, 1928, *Vortriede* (CA). AMADOR CO.: Agricultural Station, 600 m. alt., April, 1891, *Hansen 47* (M); same locality, April, 1893, *Hansen 47* (D); Middle Fork, 390 m. alt., April 28, 1893, *Hansen 47* (P); 20 mi. above Sutter Creek, May 10, 1918, *Wood* (D). CALAVERAS CO.: Mokelumne Hill, *Blaisdell* (CA, Clokey, G); Angels Camp, April 11, 1923, *Eastwood 11625* (CA); Murphys, May 17, 1887, *Smith* (PA); in open yellow pine forest, near Avery, 1050 m. alt., May 23, 1921, *Tracy 5746* (P, UC). TUOLUMNE CO.: 1 mi. above Italian Bar, T. 3 N., R. 15 E., 600 m. alt., April 13, 1936, *Belshaw 2039* (UC); Sonora, April 25, 1925, *Green* (D); in chaparral beneath scattered pines in red clay, Big Oak Flat Road, 6 mi. e. of Groveland, 1140 m. alt., May 4, 1928, *Keck 412* (D).

6. Calochortus Tolmiei Hooker & Arnott, Bot. Beechey's Voy. p. 398. 1841.

Calochortus elegans sensu J. D. Hooker in Bot. Mag. Ser. III. **28**: *t. 5976*. 1872, not Pursh, 1814.

Calochortus Maweanus Leichtlin ex Baker in Journ. Linn. Soc. Lond. Bot. **14**: 305. 1874, as to plate cited.

Calochortus coeruleus var. *Maweanus* Jepson, Fl. Calif. **1**: 301. 1921.

Calochortus elegans var. *Lobbii* Baker in Journ. Linn. Soc. Lond. Bot. **14**: 305. 1874.

Calochortus glaucus Regel in Gartenflora **24**: 260, *t. 841, fig. 1*. 1875.

Cyclanthera caerulea Elwes ex Regel, *l. c.*

Calochortus Purdyi Hort. in Gard. Chron. Ser. III. **23**: 394, *fig. 147*. 1898 (spelled *"Purdeyi"*); Eastwood in Proc. Calif. Acad. Ser. III. Bot. **1**: 137, *pl. 11, fig. 8*. 1898.

Calochortus Maweanus var. *major* Hort. ex Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**:.219. 1900; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 120. 1901.

Calochortus Maweanus var. *roseus* Hort. ex Purdy & Bailey, *l. c.*; Purdy, *l. c.* 121.

Calochortus Galei Peck in Torreya **28**: 54. 1928.

Bulb ovoid with membranaceous coats; stem simple or more frequently with a branch in the axil of the bract-like cauline leaf (very rarely the cauline leaf is lacking in depauperate specimens), usually slender and somewhat flexuous, 0.5–3 dm. tall; basal leaf 1–4 dm. long, 2–30 mm. broad, tapering toward both ends, equalling to much exceeding the stem; inflorescences subumbellate, 1–5(–10)-flowered, bracts 2 to several, lanceolate to linear, attenuate, unequal, 1–7 cm. long; flowers white or cream-colored, or variously tinged with purple or rose, erect or spreading on slender pedicels which become stouter and strongly deflexed in fruit; sepals shorter than the petals, oblong-lanceolate, acute to acuminate, glabrous; petals obovate, cuneate, acute or obtuse, more or less fringed laterally and densely bearded on the inner face above the gland with long, slender hairs; gland transverse, arched upward, surface naked, depressed, bordered below with a broad, erose to shallowly fringed membrane, and above with one or more series of short, thick processes which occasionally are united at the base to form a second membrane, both processes and fringe of the lower membrane obscurely papillose; anthers lanceolate, acute to apiculate, usually shorter than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute or obtuse, 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

From the species of the subsection ELEGANTI which do not have yellow flowers, *C. Tolmiei* is distinguished by its ordinarily branching stems and inconspicuously fringed petals which

are usually bearded to the tip. As here delimited, it is the most variable species in the section EUCALOCHORTUS. It varies greatly from locality to locality in size, coloration of flowers and other characters of minor morphological importance. Specimens from a given locality may be very uniform in these respects, but be so slightly different from those from another locality that they cannot be separated satisfactorily. This condition is not surprising when one considers the numerous barriers which must exist within the present extensive range of the species, and the probability that many of these local races have existed for a long time without appreciable genetic intermingling with the rest of the species. As a whole, however, the major morphological characters are fairly uniform, so that the treatment of the species as a single, somewhat variable entity seems amply justified.

DISTRIBUTION. In dry, often rocky soil, Seattle, Washington, southward through the Willamette and Rogue River valleys of western Oregon, and the North Coast Ranges of California, to the Santa Cruz Peninsula; also in the upper Sacramento Valley.

WASHINGTON. KING CO.: Seattle, June, 1885, *Meany* (WS); Seattle, June 4, 1883, June, 1885, *Piper* (WS).

OREGON. WASHINGTON CO.: moist, open ground, Forest Grove, May 29, 1883, *Henderson 54* (G, UO); Forest Grove, May 16, 1888, *Henderson* (UO); Forest Grove, May, 1913, *Jones* (UC); Forest Grove, May 23, 1891, *Kelsey* (NY); Forest Grove, May 20, 30, 1893, *Lloyd* (NY); dry hillsides, near Forest Grove, April 1, 1926, *Thompson 590* (D, M); same locality, May 5, 1926, *Thompson 610a* (M). CLACKAMAS CO.: dry ground, near Estacada, June 11, 1927, *Thompson 2594* (D). YAMHILL CO.: summit of Coast Mts., 25 mi. w. of McMinnville, June 27, 1893, *Spillman 68* (F); prairie, McMinnville, April 5, 1871, *Summers 840* (UC). POLK CO.: rocky thicket on hillside, Eola, May 14, 1916, *Nelson 578* (D). MARION CO.: Fairmount Hill, Salem, May 13, 1918, *Brasher* (D); Silverton, June, 1881, *Howell* (PA); near Salem, June 28, 1893, *Howell 572, in part* (UC); open ground, Salem, May 15, 1919, *Hunt* (D); Rosedale, May 10, 1918, *Jones* (D); grassy hillside, Salem, April 24, 1915, *Nelson 75* (D); gravelly pasture, Salem, May 20, 1917, *Nelson 1153* (G); grassy thicket on Fairmount Hill, Salem, May 8, 1921, *Nelson 3595* (PA); Salem, May 6, 1910, *Peck 1378* (WU); field near Stayton, May, 30, 1932, *Peck 17002* (WU). LINN CO.: dry ground, 4 mi. s. of Jefferson, May 20, 1928, *Gale 215* (D, G, M); 2½ mi. e. of Corvallis, May 25, 1918, *Lawrence 1580* (D); open, dry ground, 4 mi. s. of Stayton, May 27, 1925, *Peck 13719* (F, G, WU, WS), type collection of *C. Galei* Peck; canyon of Santiam River, near Cascadia, June 30, 1926, *Peck 14530a* (WU); stream bank, near Cascadia, June 3, 1926, *Peck 14641a* (WU). BENTON CO.: roadways, open places, Corvallis, May 6, 1922, *Epling 5061* (UCLA); Philomath, June 21, 1926, *Gale* (PA); dry slope, 2 mi. n. of Corvallis, May 20, 1928, *Gale 212* (D, M, PA);

10 mi. n. w. of Corvallis, April 30, 1919, *Luedinghaus* (M); hillside, 2 mi. n. w. of Corvallis, 66 m. alt., May 18, 1912, *Owens* (D). LANE CO.: grassy south slope, Coburg Hills, Coburg, n. of Eugene, April 19, 1924, *Constance* (UC); grassy slopes, vicinity of Eugene, May 31, 1925, *Constance* (UC); open fields, Eugene, March 14, 1927, *Constance* (WS); grassy, moist, sunny slopes, Lorane Road, near Eugene, May 17, 1931, *Henderson 13578* (PA); grassy hills, Spencer Creek District, April 8, 1934, *Henderson 16170* (UO); meadows and copses, north base of Spencers Butte, May 3, 1934, *Henderson 16294* (UO); exposed hillsides, Coburg, May 7, 1923, *Wynd 1244* (M). DOUGLAS CO.: 19.6 mi. w. of Roseburg, on Marshfield Road, May 13, 1924, *Abrams & Benson 10519* (D); thickets and oak forests, dry hills about Roseburg, Umpqua Valley, April 13, 1924, *Cusick 3882* (WS); hillside, 6 mi. s. of Myrtle Creek, April 28, 1928, *Gale 45* (D, M, P, PA); sunny banks, West Fork of Cow Creek, near bridge, June 6, 1930, *Henderson 12784* (UO); dry slopes, 4 mi. w. of Dothan P. O., June 20, 1917, *Nelson* (G); Roseburg, May 13, 1920, *McMillen* (WU); east foot of Nine-Mile Mt., along West Fork Marial Trail, June 20, 1917, *Peck 3204* (WU); open woods, near Douglas-Josephine Co. Line, on West Fork Marial Trail, June 27, 1917, *Peck 3204* (F); open rocky bluffs at Roseburg, April 8, 1934, *Thompson 10159* (D, M, NY, P, WU); Myrtle Creek, May 18, 1915, *Smith* (CA). KLAMATH CO.: near Pinehurst, May, 1936, *Bellinger* (WU). JACKSON CO.: 1–2 mi. below Siskiyou, May 9, 1924, *Abrams & Benson 10221* (D); head of Jackson Creek, May 10, 1924, *Abrams & Benson 10264* (D); along wooded stream, Carter Creek, north slope of the Siskiyou Mts., s. of Ashland, May 30, 1896, *Applegate 725a* (D); in granite soil on dry oak hills, along Neil Creek, near Ashland, 720–840 m. alt., May 17, 1898, *Applegate 2164* (D); yellow pine woods, Jenny Creek, near Pinehurst, Cascade Mts., May 11, 1924, *Applegate 4052* (D, UC); oak woods, Rogue River, near Gold Hill, April 8, 1925, *Applegate 4155* (D); yellow pine woods, Jenny Creek, about 2 mi. above Pinehurst, Cascade Mts., May 26, 1925, *Applegate 4306* (D, UC); along wooded stream, Keene Creek Canyon, opposite sawmill, Cascade Mts., June 9, 1925, *Applegate 4354* (D, UC); dry, brushy hillside among oaks, Jacksonville Creek, above Jacksonville, April 5, 1926, *Applegate 4592* (D, UC); Wimer, March, April, 1889, *Hammond* (G); Sykes Creek, April 29, 1892, *Hammond 389* (M); near Wimer, May 13, 1892, *Hammond 389* (NY); hills, 20 mi. e. of Medford, June, 1927, *Heckner* (PA, WU); open woods and sunny slopes, Gold Hill, May 5, 1930, *Henderson 12263* (UO); manzanita hills, above Normal School, April 22, 1930, *Henderson 12458* (UO); north slope of Siskiyou Mts., just below summit and Inn, June 13, 1930, *Henderson 12679* (UO); Sunny Creek, n. of Siskiyou Camp, June 13, 1930, *Henderson 12786* (UO); Woodville, May 1, 1889, *Howell* (PA); near Woodville, May, 1890, *Howell 572, in part* (WS); Siskiyou Summit, 1380 m. alt., June 23, 1929, *Kildale & Gillespie 8279* (D); dry hillsides, R. R. crossing of Siskiyou Mts., s. of Ashland, 900 m. alt., June 9, 1899, *Leiberg 4018* (UO); mountainside, near Ashland, July 12, 1913, *Peck 1377* (WU); dry slope, 7 mi. s. e. of Ashland, June 19, 1927, *Peck 14996* (WU); sides of Ashland Canyon, Ashland, June, 1908, *Rose 8* (D); top of Siskiyou Mts., near Siskiyou, May 21, 1924, *Sherwood 608* (WU); Ashland, May 6, 1914, *Smith 663* (CA); wooded slopes of Table Rock, near Medford, April 12, 1934, *Thompson 10310* (M, NY, WU). JOSEPHINE CO.: Deer Creek to Kerby, May 11, 1924, *Abrams & Benson 10318* (D); Waldo, May 11, 1924, *Abrams & Benson 10362* (D); 4 mi. w. of Grants Pass, on Crescent City Road, May 11,

1924, *Abrams & Benson 10396* (D, RM); yellow pine and oak woods, east slope of Eight Dollar Mt., near Clear Creek, June 14, 1929, *Applegate 5725* (D); yellow pine woods, east slope of Eight Dollar Mt., Illinois River Valley, June 18, 1932, *Applegate 7284* (D); yellow pine woods, Waldo, June 19, 1932, *Applegate 7317* (D); Grants Pass, April 18, 1905, *Baker* (UC); near Waldo, May 18, 1936, *Bellinger* (WU); near Jones Creek, Grants Pass, April 13, 1913, *Dale* (D); meadow, Grants Pass, May, 1887, *Drake & Dickson* (F); Caves City to Waldo, April 12, 1934, *Eastwood & Howell 1356* (CA); dry ground, between Kerby and Selma, April 28, 1928, *Gale 18* (D, M, P, PA); hillside, 1 mi. s. of Wolf Creek, April 28, 1928, *Gale 43* (D, M, PA); south side of Sexton Mt., April 30, 1928, *Gale 84* (D, M, P, PA); dry hillside, near Waldo, May 20, 1928, *Gale 241* (D, M, PA); bushy plains, Silver Creek, 1871, *Hall 525* (F, G, M, NY); Grants Pass, May 16, 1910, *Heller 10116* (D); yellow pine forest, under and about shrubs, at the summit of the Siskiyou Mts., 1350 m. alt., June 21, 1922, *Heller 13630* (D, F, M, NY); moist meadows, Grants Pass, May 7, 1887, *Henderson 983* (G, UO); *Ceanothus* and manzanita hills, near Grants Pass, March 20, 1926, *Henderson 5784* (CA, D, M, RM, UO); wet, rocky, red-clay flat, base of Eight Dollar Mt., near Selma, April 14, 1926, *Henderson 5988* (D); wet, sticky soil amongst rocks, hills down Deer Creek, 4 mi. from Selma, April 11, 1926, *Henderson 5989* (CA, D, M, RM, UO); Greenback, 750 m. alt., July 10, 1905, *Kemp* (NY); Waldo, 450 m. alt., May 18, 1930, *Kildale & Kildale 9599* (D); Waldo Junction, 450 m. alt., May 18, 1930, *Kildale & Kildale 9636* (D); dry slope, 3 mi. w. of Merlin, March 24, 1927, *Peck 14767* (WU); Eight Dollar Mt., June 13, 1904, *Piper 5089* (G); Grants Pass, April 6, 1912, *Prescott* (D, F, WU); along Rogue River, 5 mi. e. of Grants Pass, May 16, 1924, *Sherwood 773* (WU); Merlin, May 17, 1915, *Smith* (CA); hills and plains, about Grants Pass, May 3, 1906, *Sweetser* (PA); Kerby, May 20, 1922, *Sweetser* (UO, WU); serpentine, Page Mt., May 21, 1923, *Sweetser* (UO); south side of Sexton Mt., April 7, 1927, *Thompson 2070* (D); south slope of Sexton Mt., April 12, 1927, *Thompson 2284* (M); forested slopes of Mt. Grayback, 1200–1800 m. alt., June 27, 1936, *Thompson 12973* (NY, PA, WS). COOS CO.: Shell Mound, Cape Arago, Sept. 24, 1911, *Haydon 21* (F, UCLA); county road to lighthouse, June 6, 1911, *Haydon 100* (CA, F); top of sea-cliff, near Charleston, July 3, 1926, *Scullen* (UO); camp ground at Bandon, June 3, 1928, *Thompson 4429* (D, G, M); open bluffs and beaches at Bandon, June 20, 1936, *Thompson 12788* (M). CURRY CO.: hills back of Gold Beach, May 16, 1924, *Abrams & Benson 10653* (D); in serpentine, summit, Pistol River to Brookings, May 16, 1924, *Abrams & Benson 10682* (D); near summit of Mt. Emily, along the Chetco River, July 13, 1929, *Andrews 11673* (UO); Illinois River, near confluence with Rogue River at Agness, May 9, 1932, *Applegate 7106* (D); grassy, sub-sunny hill of Chetco River, opposite Moore's, May 12, 1929, *Henderson 10134* (PA); hillside, Gold Beach, May 24, 1915, *Hoyt 42* (D, NY); along Agness-Port Orford Trail, 3 mi. n. w. of Agness, June 23, 1917, *Peck 3203* (WU); meadow, The Heads, Port Orford, June 20, 1919, *Peck 9055* (G, M, NY, WU); Snow Camp, 1200–1275 m. alt., July, 1916, *Thompson 63* (D); Brookings, May, 1915, *Thompson 103* (D); summit of Pistol River Mt., June 4, 1928, *Thompson 4549* (D); on serpentine ridges near Snow Camp Mt., Siskiyou Mts., 1350 m. alt., June 22, 1936, *Thompson 12853* (M). COUNTY UNCERTAIN: "Wallamet," *Tolmie* (Kew TYPE); "Oregon," *Lobb 257* (Kew, type of *C. elegans* var. *Lobbii* Baker); "Willamette Valley," cultivated specimen, *Purdy* (CA, type of *C. Purdyi* Eastwood).

CALIFORNIA. SISKIYOU CO.: Klamath River at Somesbar, April 14, 1928, *Kildale 4596* (D). DEL NORTE CO.: Adams Station, across Smith River, April 26, 1907, *Eastwood 115* (CA); Big Flat, 240 m. alt., June 29, 1930, *Kildale 9934* (D); French Hill, 600 m. alt., June 8, 1930, *Kildale & Kildale 9686* (D); openings among brush, summit of ridge, state line n. of Monumental, at head of Shelley Creek, California side, 930 m. alt., June 13, 1936, *Parks & Tracy 11380* (UC); rocky hillsides, Douglas Park, June 5, 1928, *Thompson 4525* (D, M, P). TRINITY CO.: head of Grizzly Creek, 1800 m. alt., July 21, 1911, *Alexander & Kellogg 269* (UC); brushy, high hill, near Weaverville, May 24, 1933, *Henderson 15445* (UO); Wildwood, 1140 m. alt., May 15, 1931, *Holman* (UC); Weaverville, April 22, 1915, *Junkens* (CA, G); Weaverville, April 25, 1916, *Junkens* (CA); Trinity Center, April 30, 1928, *Kildale 4604* (D); dry, stony slopes and in moister situations, near Weaverville, 615 m. alt., May 15, 1914, *Yates 268* (UC). HUMBOLDT CO.: Trinidad Head, 1899, *Dudley* (D, NY); open woods, prairies and ledges on Chalk Mt., near Bridgeville, June 12, 1936, *Harris & Harris 3330* (G); 25 mi. n. of Garberville, May 2, 1931, *Jussel* (CA); gravelly river terrace, Willow Creek Flat, 150 m. alt., May 2, 1926, *Kildale 1851* (D); Redwood Creek at Berry's, 285 m. alt., May 13, 1927, *Kildale 3248* (D); Willow Creek-Salyer Road, along Trinity River, 3 mi. n. of Willow Creek, April 27, 1929, *Kildale 7451* (D); Snow Camp, May 10, 1931, *Kildale 10563* (D); on ridges, Laribee Valley, May 25, 1930, *Parks & Tracy 0790* (F, UC); Eureka, April 28, 1918, *Paulson* (D, NY, UO); Long Prairie, June 7, 1879, *Rattan 13* (D, G); Lighthouse, Trinidad, June 3, 1911, *Smith 3759* (F, NY); edge of brush, Butler Valley, 150 m. alt., June 7, 1908, *Tracy 2612* (UC); Kneeland Prairie, 750 m. alt., June 8, 1908, *Tracy 2624* (UC); partial shade, Dinsmore's Ranch, in valley of Van Duzen River, opposite Buck Mt., 750 m. alt., June 22, 1913, *Tracy 4263* (UC); in sheltered, grassy place, sand dunes w. of Dows Prairie, 15 m. alt., May 30, 1917, *Tracy 4813* (CA, P, UC); along bluff between Alton and Burnells, near Hydesville, 30–90 m. alt., May 11, 1912, *Tracy & Babcock 3621* (UC). SHASTA CO.: brushy hillside among oaks, 4 mi. s. of Baird, near mouth of Pit River, April 25, 1928, *Applegate 5389* (D); Old Cow Creek Canyon, April 30, 1900, *Baker* (UC); Goose Valley, May 26, 1894, *Baker & Nutting* (UC); Redding, April 16, 1923, *Bethel* (CA); Montgomery Creek, April 18, May 6, 1923, *Bethel* (CA); Burney, May 31, 1923, *Bethel* (CA); Pollards Gulch, April 21, 1934, *Eastwood & Howell 1803* (CA); w. of Beegum, on old road from Red Bluff to Fortuna, April 23, 1933, *Holman* (UC); near Whiskeytown, April 6, 1927, *Howell 2310* (CA); Redding, April 4, 1910, *Jones 47* (G); Ydalpom, April 29, 1918, *McAllister* (CA); Iron Mt., April 14, 1914, *Smith 629* (CA, G). TEHAMA CO.: thickets of brush, Beegum, April 13, 1932, *Applegate 7048* (D, UC). BUTTE CO.: mountains above Chico, May 16, 1878, *Bidwell* (G); Forest Ranch, June, 1897, *Bruce 2407* (D); mountains, May, 1898, *Bruce 2407* (D, NY, P); Chico, April 10, 1903, *Copeland 3023* (F, G, M, P, UC); De Sabla, May, 1917, *Edwards* (D, NY); near Stirling, 1057 m. alt., June 7, 1913, *Heller 10812* (D); on serpentine, in the yellow pine and oak belt, near Magalia, May 5, 1918, *Heller* (CA); in fine gravel, open places, yellow pine and Kellogg oak belt, Stirling, 1056 m. alt., May 18, 1919, *Heller 13168* (CA, D, F, G, M, NY, PA); in rich soil about serpentine rocks, in the yellow pine belt, Magalia, April 29, 1928, *Heller 14534* (D, M, NY); Durham, April 17, 1932, *Morrison* (CA); near De Sabla, May 5, 1918, *Van Eseltine 1738* (G). MENDOCINO CO.: South Mill Creek Canyon, on the road to Carl Purdy's, near Ukiah, April 28,

1918, *Abrams 6924* (D); Ukiah, *Armstrong 893* (NY); yellow pine forest, Mt. Sanhedrin, 1260 m. alt., May 29, 1927, *Bacigalupi 1528* (D, P); dry hillsides, Ukiah, 1864, *Bolander 3933* (F, G, UC); Long Valley, 1866, *Bolander 4712* (F, M, UC); Rowes, 150 m. alt., May 11, 1901, *Chandler 1049* (UC); between Orrs Spring and Mendocino City, June 22, 1894, *Eastwood* (G); Ukiah, June 13, 1913, *Eastwood 3360* (CA); trail to Buck Rock, Forest Reserve, June 7, 1928, *Eastwood 15280* (CA); 10 mi. s. of Cummings, April 10, 1934, *Eastwood & Howell 1319* (CA); near Bell Springs, June 21, 1937, *Eastwood & Howell 4610A* (CA); sunny hillside, near Coolidge Redwoods, May 26, 1933, *Henderson 15432* (UO); grassy road along ocean bluffs, Elkhorn Cabins, May 25, 1933, *Henderson 15455* (UO); near Handleys, May, 1903, *McMurphy 170* (D, NY); Willits, May 21, 1921, *Piper* (CA); Ukiah, *Purdy* (F, G, UC); stony slopes, Sanhedrin, 900–1500 m. alt., May 1894, *Purpus 879* (UC); Round Valley, *Westerman* (UC). GLENN CO.: in open places in the forest, yellow pine belt, Houghtons Trail, near Bennet Spring, on the Newville-Covelo Road, 960 m. alt., June 3, 1915, *Heller 11946* (CA, D, F, G, M, NY). LAKE CO.: 6 mi. up grade, west side of Bartlett Mt., May 6, 1928, *Abrams 12418* (D); brushy hills, Egan's Ranch, Pine Grove, near and n. of Cobb Mt., March 8, 1934, *Applegate 8890* (D); southeast slope of Cobb Mt., near "Whispering Pines," 840 m. alt., May 1, 1927, *Baker 2105a* (UC); upland pine woods, Siegler Springs, April 29, 1923, *Blankinship* (CA); Dashiells, Mt. Sanhedrin, May 25, 1925, *Eastwood 12858* (CA); Elk Mt., 1110 m. alt., May 17, 1938, *Eastwood & Howell 5698* (CA); 4 mi. up Bartlett Springs Grade, May 6, 1928, *Wolf 1975* (D). NAPA CO.: 4 mi. s. of Middletown, May 4, 1928, *Abrams 12291* (D); Middletown Grade, near Lake Co. Line, May 5, 1893, *Jepson* (UC); Calistoga, April, 1922, *Wright* (CA). SONOMA CO.: Coast Road, April 5, 1898, *Baker 5* (UC); hills back of Dillon's Beach, April, 1899, *Baker* (UC); Bodega, April, 1901, *Eastwood* (G, NY); Bodega Bay, April 11, 1902, *Heller & Brown 5263* (D, F, G, M, NY, P, PA). MARIN CO.: Inverness, April, 1920, *Kelley* (CA); Point Reyes, May, 1906, *Eastwood* (CA). SAN MATEO CO.: Kings Mt., May 20, 1902, *Abrams 2473* (D, M, NY); new La Honda Grade, May 15, 1922, *Bacigalupi* (P); Kings Mt., May 10, 1902, *Baker 796* (P); wet shaded places, above Woodside, Santa Cruz Mts., 240 m. alt., May 3, 1930, *Benson 2107* (G); dry woods, near Pescadero Creek, June 6, 1895, *Dudley* (D, P); Kings Mt., April 27, 1907, *Dudley* (D); Kings Mt., Sierra Morena Ridge, May 18, 1920, *Hichborn* (M); Kings Mt., April 27, 1907, *Randall 225* (D). SANTA CLARA CO.: in chaparral on rocky slope, Mt. Umunhum, 1020 m. alt., May 9, 1920, *Davis* (D); Uvas Canyon, April 18, 1926, *Howell 1909* (CA). SANTA CRUZ CO.: on road up to Cattermoles, Loma Prieta, May 30, 1893, *Dudley* (D); California Redwood Park, June 7, 8, 1919, *Shockley* (D). COUNTY UNCERTAIN: cultivated specimen, bulbs from California (Leningrad, type of *C. glaucus* Regel; M, photograph).

7. Calochortus coeruleus (Kellogg) Watson in Proc. Am. Acad. **14**. 263. 1879.

Cyclobothra coerulea Kellogg in Proc. Calif. Acad. **2**: 4. 1863.

Calochortus Maweanus Leichtlin ex Baker in Journ. Linn. Soc. Lond. Bot. **14**: 305. 1874, as to specimen cited *(Lobb 242)*.

Bulb ovoid, with membranaceous coats; stem low, usually scapiform, slender, erect or somewhat flexuous; basal leaf 1–2 dm. long, 2–10 mm. broad, tapering toward both ends, greatly exceeding the stem; inflorescence subumbellate, 1–5(–10)-flowered, bracts 2 to several, lanceolate to linear, acuminate, unequal; flowers bluish, erect or spreading on slender pedicels which become strongly deflexed in fruit; sepals slightly shorter than the petals, oblong-lanceolate, acuminate, glabrous; petals obovate, acute or obtuse, clawed, inner face smooth, laciniate-ciliate and bearded above the gland with long, coarse hairs; gland transverse, arched upward, surface naked, slightly depressed, bordered below with a broad, ascending, erose to shallowly fringed membrane, and above with a series of short, thick processes, both processes and membrane-fringe densely papillose; anthers large, oblong, acute, usually equally or exceeding the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute, nodding; seeds with hexagonally reticulate coats.

Calochortus coeruleus is distinguished from *C. elegans*, which it resembles in size and habit, by its large, oblong anthers and more conspicuously ciliate, more densely bearded petals, which are not papillose on the inner face.

DISTRIBUTION. California: in open coniferous forests, Lassen and Tehama counties, southward in the Sierra Nevada to Amador County.

CALIFORNIA. LASSEN CO.: Susanville, July 2, 1892, ex herb. *Brandegee* (D). PLUMAS CO.: without exact locality, May, 1876, *Austin* (F, G); Forest Lodge, Greenville, June 11, 1927, *Eastwood 14456* (CA, P); Nelson Point, 1350 m. alt., June 25, 1912, *Hall 9395* (UC); open hillsides, Massack Creek, 1410 m. alt., May 25, 1919, *Wagner 261* (D). TEHAMA CO.: in loose soil (leaf mold) among creeping shrubs, summit of mountain between Mineral and Viola, 3 mi. n. of Mineral, July 15, 1938, *Ownbey & Ownbey 1743* (G, Kew, M, O, RM, UC). BUTTE CO.: Colby, July, 1896, *Austin 74* (M); near Stirling, 1056 m. alt., June 7, 1913, *Heller 10812* (D, F, G, M, NY, PA, UC); open gravelly places in the yellow pine forest, Butte Meadows, June 20, 1928, *Heller 14623* (D, M, NY). SIERRA CO.: Camptonville District, Tahoe National Forest, May, 1931, *Smith* (UC). NEVADA CO.: Bear Valley, *Bolander & "Kellock"* [*Kellogg*] (G); by Baltic Trail, June 14, 1893, *Dudley* (D); Bear Valley, *Hartweg 1988* (G, NY). PLACER CO.: Cisco, 1872, *Bolander & Kellogg* (G); Red Point, 1350 m. alt., July, 1892, *Price* (D); Blue Canyon, 1410 m. alt., June 23, 1908, *Walker 1242* (UC). ELDORADO CO.: Armstrongs Station, 1590 m. alt., June 13, 1895, *Hansen 1071* (P, UC). AMADOR CO.: Hams Station, 1500 m. alt., May, 1895, *Hansen 1071* (D, M). COUNTY UNCERTAIN: "California," 1857, *Lobb 242* (Kew).

7a. Calochortus coeruleus var. **nanus** (Wood) Ownbey, n. comb.

Calochortus elegans var. *nanus* Wood in Proc. Acad. Philad. [20]: 168. 1868.

Calochortus nanus Piper in Bull. Torr. Bot. Club **33**: 537. 1906.

Anthers smaller, lanceolate, short-apiculate; otherwise as in the species.

In the character of the anthers this variety approaches *C. elegans,* but by all other criteria, including geographical distribution, it clearly belongs with *C. coeruleus.*

DISTRIBUTION. California: in open coniferous woods, vicinity of Mount Shasta, southward in the North Coast Ranges to Lake County; infrequent except in the Mount Shasta Region.

CALIFORNIA. SISKIYOU CO.: dry woods, Sisson, May 28, 1895, *Applegate 725* (D, G); Sisson, June 10, 1896, *Baker 97* (UC); McCloud, May 22, 1923, *Bethel* (CA); north side of Mt. Shasta, 1500–2700 m. alt., June 11–16, 1897, *Brown* (M, NY); Mt. Bradley, near Shasta Retreat, 1800 m. alt., July 5, 1911, *Condit* (UC); Shasta Springs, May 20, 1923, *Eastwood 11856* (CA, NY); Dunsmuir, 600 m. alt., June, 1903, *Hall & Babcock 4033* (UC); near Sisson, June 15, 1905, *Heller* (CA); in open places in the forest, Metcalf's Ranch, northeast base of Mt. Eddy, 1140 m. alt., June 1920, *Heller 13386* (D, F, M, NY); Shasta Springs, May, 1920, *Herrin* (CA); Salmon Summit, via Horn Creek Trail, 1950 m. alt., July 2, 1928, *Kildale 5348* (D); Dunsmuir, May 12, 1913, *Smith 208* (CA); Sisson, June 9, 1914, *Smith 713* (CA, G); mountains w. of Yreka, June, 1866, *Wood 967* (G TYPE). SHASTA CO.: in pine woods, Castle Crags, May 30, 1904, *Piper 6398* (G); Sweetbriar Creek, Castella, 1050 m. alt., June 6, 1916, *Rosenbaum* (UC). TRINITY CO.: Trinity Summit, June 21–23, 1899, *Davy 5744½* (UC); Scott Mts., n. of Carrville, June 25, 1937, *Eastwood & Howell 4987* (CA); Trinity Summit, July 1–15, 1901, *Manning 8* (UC). HUMBOLDT CO.: Blake Lookout, South Fork Mt., 1700 m. alt., June 7, 1931, *Gillespie 10586* (D). GLENN CO.: barren soil under conifers, Plaskett Meadows, 8 mi. s. e. of Mendocino Pass, July 12, 1938, *Ownbey & Ownbey 1724* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS). LAKE CO.: Mt. Hull, 1950 m. alt., July 25, 1913, *Hall 9558* (UC).

7b. Calochortus coeruleus var. **Westoni** (Eastwood) Ownbey, n. comb.

Calochortus Westoni Eastwood in Proc. Calif. Acad. Ser. IV. Bot. **20**: 136. 1931.

Petals lanceolate, acute, laciniate-ciliate laterally only; anthers lanceolate, apiculate; otherwise as in the species.

This variety is very close morphologically to *C. coeruleus* var. *nanus,* but apparently may be distinguished by its much

narrower, less conspicuously fringed petals. The three plants on the type sheet are very uniform in their short scapes and numerous (5–7) flowers, but these characters may be expected to vary when more material is available. Two statements in the original description should be corrected. (1) The number of bracts is not "generally two," but is approximately equal to the number of flowering pedicels which they subtend. (2) The gland is not "covered with short crisped hairs," but with short, thick processes which are densely beset distally with long papillae.

DISTRIBUTION. California: known only from the type collection.

CALIFORNIA. KERN CO.: saddle at summit of the Greenhorn Mts., above Shirley Meadows, May 20, 1927, *Weston 680* (CA TYPE).

8. Calochortus elegans Pursh, Fl. Am. Sept. **1**: 240. 1814.

Cyclobothra elegans Bentham ex Lindley in Bot. Reg. **20**: under *t. 1662.* 1834.

Calochortus elegans α. *minor* Hooker, Fl. Bor. Am. **2**: 183. 1839.

Calochortus elegans β. *major* Hooker, *l. c.*

Bulb ovoid, with membranaceous coats; stem usually scapiform, 5–15 cm. tall, slender and more or less flexuous; basal leaf 1–2 dm. long, 2–10 mm. broad, tapering toward both ends, usually greatly exceeding the stem; inflorescence subumbellate, 1–2(–7)-flowered, bracts 2 to several, lanceolate to linear, acuminate, unequal; flowers greenish white, often with a purple crescent on each petal above the gland and a similar blotch on each sepal, erect or spreading on slender pedicels which become strongly deflexed in fruit; sepals shorter than the petals, oblong-lanceolate, acute to acuminate, inner face minutely papillose and usually glabrous; petals oblanceolate or broader, acute or obtuse, clawed, inner face papillose, fringed laterally and densely bearded above the gland with long, slender, more or less flexuous hairs; gland transverse, arched upward, surface depressed, naked, bordered below with a narrow, ascending, deeply fringed membrane, and above with one or more series of short, thick processes, both processes and the fringe of the membrane densely papillose; anthers lanceolate, long-apiculate, exceeding the basally dilated filaments in length;

ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic to orbicular, obtuse or acute, 3-winged, nodding; seeds irregular, with light brown, hexagonally reticulate coats.

This species is most closely related to *C. coeruleus*, with which it agrees in size and habit, but from which it is distinguished by its lanceolate, apiculate anthers and its papillose, less conspicuously fringed and bearded petals.

DISTRIBUTION. Grassy hillsides and open coniferous woods, central Idaho and adjacent Washington and Oregon.

IDAHO. LATAH CO.: Moscow, May, 1900, *Abrams 605* (D, M, NY, UC); Cedar Mt., June 6, 1925, *Bartlow* (RM); northeast ridge, Cedar Mt., July 2, 1911, *Beattie 4312* (WS); Moscow Mt., June 1, 1895, *Cloud* (WS); rocky outcrop in *Abies-Thuja-Pseudotsuga* forest, crest of ridge west of Cedar Peak, May 23, 1936, *Constance, Peters & Dillon 554* (WS); Moscow Mt., July, 1929, *Epling* (UCLA); grassy hills, Moscow, May 30, 1894, *Henderson 2483* (RM); Cedar Creek, 1900, *Ried* (WS); shady places near Julinetta, June 8, 1892, *Sandberg, MacDougal & Heller 344* (CA, G, NY). NEZ PERCE CO.: near Summit, May 21, 1903, *Bashor* (WS); near Lake Waha, Craig Mts., June 25, 1902, *Beattie* (WS); about Lake Waha, 1050–1200 m. alt., June 3, 4, 1896, *Heller & Heller 3172* (M, NY, UC); dry slopes, near Lake Waha, 700 m. alt., July, 1891, *Leiberg* (UO); hillsides, region of Lake Waha, May 20, 1892, *Sandberg, MacDougal & Heller 196* (CA, D, F, G, M, NY, P, PA, WS); prairie hillside on foothills of Craig Mts., 1 mi. n. w. of Lake Waha, May 15, 1938, *Sharsmith 3553* (O). IDAHO CO.: grassy slopes above Sheep Creek, T. 25 N., R. 2 W., Snake River Canyon, 600 m. alt., May 16, 1936, *Constance, Rollins & Dillon 1602* (D, M, WS); S. 1, T. 25 N., R. 1 W., Nez Perce National Forest, 1410 m. alt., July 10, 1922, *Deasy 6* (UM); rocky soil on dry, bare ridge, 1 mi. s. e. of the mouth of Sheep Creek, T. 25 N., R. 2 W., Snake River Canyon, 660 m. alt., May 16, 1936, *Gaines 72* (UC); moist, grassy hillsides in the Seven Devils Mts., above the Snake River, Snake River Canyon, and above Sheep Creek, May 16, 1936, *Meyer 251* (O); old burn, moist, north slope, Three Creeks Saddle, 1260 m. alt., June 13–30, 1937, *Packard 273* (WS); Lolo Trail, ridge above Clearwater, Aug. 23, 1880, *Watson 418* (G). LEMHI CO.: rocky ground along ridge, in medium stand of lodgepole pine, North Fork of Crone Creek Trail, 2100 m. alt., June 16, 1936, *Blair* (O); open hillside, Salmon, 1500 m. alt., June 27, 1920, *Payson & Payson 1805* (CA, Clokey, G, M, NY, RM). ELMORE CO.: Twin Springs, May 17, 1937, *Price* (O).

WASHINGTON. WHITMAN CO.: moist slope, ¾ mi. w. of Pullman, 600 m. alt., May 11, 1930, *Clarke* (WS); hillsides, Pullman, June 6, 1896, *Climer* (WS); meadows, Pullman, July 4, 1896, *Elmer 62* (P); meadows, Pullman, June 20, 1896, *Elmer 220* (RM); near Pullman, 1892, *Henderson 2483* (G); Pullman, May 16, 1892, *Hull 811* (WS); in dense wooded land, north side of Kamiak Butte, May 28, 1922, *Parker 416* (WS); Pullman, June 10, 1896, *Piper* (UO); under dense brush of *Prunus emarginata*, Kamiak Butte, May 14, 1938, *Sharsmith 3548* (O). ASOTIN CO.: pine woods, 1½ mi. w. of Anatone, May 15, 1926, *Gessell* (P, WS); open woods, Blue Mts., June 1928, *Jones 981* (WS); Wenatchee Ranger Station, Blue Mts., 1650 m. alt., July 19, 1923, *Shaw* (WS). GARFIELD

CO.: north exposure, bunch-grass prairie, 8 mi. s. of Pomeroy, April 28, 1934, *Pickett 1490* (WS). COLUMBIA CO.: Blue Mts., T. 9 N., R. 40 E., July, 1913, *Darlington* (WS); open ridges, Wolf Fork of Touchet River, May 30, 1925, *St. John, Davison & Scheibe 6956* (WS). WALLA WALLA CO.: Blue Mts., June 10, 1911, *Hill* (WS); hillsides, Waitsburg, May 1, 1897, *Horner B485* (G).

OREGON. WALLOWA CO.: summit of Imnaha-Snake Divide, 23 mi. above Imnaha, July 12, 1933, *Peck 17625* (WU); dry woods, 28 mi. n. of Enterprise, June 21, 1934, *Peck 18221* (D, NY, WU); west slope of Mt. Wilson, 1260 m. alt., May 20, 1897, *Sheldon 8106* (M, NY). UNION CO.: Kamela, 1260 m. alt., June 1, 1910, *Heller 10143* (PA). UMATILLA CO.: gravelly bottom, in thickets, along the Umatilla River, 1 mi. above Bingham Station, 530 m. alt., May 21, 1908, *Cusick 3238* (D, F, G, M, NY, RM, UC, UO, WS); 15 mi. n. e. of Pendleton, May 17, 1923, *Sherwood 376* (WU); near Emigrant Springs, near summit of Blue Mts., June 14, 1928, *Thompson 4725* (D, M). BAKER CO.: dry, shaded soil of Pine Creek, May 25, 1898, *Cusick 1894* (F, G, M, P, UC, WS).

8a. Calochortus elegans var. **selwayensis** (St. John) Ownbey, n. comb.

Calochortus selwayensis St. John in Proc. Biol. Soc. Wash. **41**: 192. 1928.

Gland shorter, nearly straight, not depressed; petals only moderately bearded; otherwise as in the species.

DISTRIBUTION: Open coniferous forests in the Bitterroot Mountains of western Montana and adjacent Idaho.

MONTANA. SANDERS CO.: without exact locality, May, 1938, *Hecht* (Beal). MISSOULA CO.: near Bear Creek, upper Lolo Valley, June, 1916, *Kirkwood* (UM); in woods on flats, Lolo Valley, about 15 mi. from Lolo, July 9, 1921, *Kirkwood 1054* (M); Lolo Divide, June 28, 1937, *Rose 491* (O). RAVALLI CO.: in pine woods, Lake Como, 1440 m. alt., June 19, 1906, *Blankinship 792* (F, M, P, RM, UC, UM).

IDAHO. SHOSHONE CO.: Bearskull Mt., St. Joe National Forest, July, 1929, *Epling* (UCLA); near Stevens Peak, 1980 m. alt., Aug. 4, 1895, *Leiberg 1467* (M, NY, UO). BENEWAH CO.: Santa, July, 1929, *Epling* (UCLA); along St. Maries River, 990 m. alt., June 27, 1895, *Leiberg 1087* (G, M, NY, UO). IDAHO CO.: moist, shady place beside Paradise Creek, T. 32 N., R. 14 E., 1200 m. alt., June 29, 1927, *Baker* (WS TYPE); same locality, June 24, 1928, *Baker* (G, WS); near Indian P. O., Lolo Trail, Bitterroot Mts., July 21, 1902, *Piper 4104* (WS). COUNTY NOT DETERMINED: in the Palouse country and about Lake Coeur d'Alene, June, July, 1892, *Aiton* (D, F, M, NY).

8b. Calochortus elegans var. **oreophilus** Ownbey, n. var.[27]

Membrane below the gland erose to shallowly fringed; hairs of petal usually more sparse, shorter and thicker; petals more conspicuously fringed; otherwise as in the species.

[27] **Calochortus elegans** var. **oreophilus** var. nov., membrana subter glandulam erosa vel anguste fimbriata; pilis petali plerumque sparsioribus brevioribus crassioribus; petalis insignius fimbriatis; aliter similis speciei.

DISTRIBUTION. On grassy slopes or in open coniferous forests, Cascade Mountains from eastern Douglas County, Oregon, southward to the California Line, and in the mountains of western Siskiyou County, California.

OREGON. DOUGLAS CO.: openings in fir woods, between Hershberger Mt. and Rabbit Ears, Rogue River Watershed, July 13, 1929, *Applegate 6027* (D); lodgepole pine woods, beyond Diamond Lake, towards Windigo Pass, 1500 m. alt., July 9, 1929, *Henderson 12881* (PA, UO); Diamond Lake, June 21, 1931, *Howell 6880* (CA); dry, grassy slope about Diamond Lake, July 13, 1936, *Peck 19273* (WU). KLAMATH CO.: open ground in moss, side of Mt. Scott, 1350 m. alt., July 22, 1899, *Barber 36* (G); dry, grassy soil, Longs Prairie, June 26, 1931, *Evans 329* (UO); dry, wooded slope, west side of Four-Mile Lake, July 2, 1931, *Peck 18543* (WU); Red Blanket Creek, Crater Lake Park, July 2, 1928, *Wynd 2089* (UO). JACKSON CO.: dry, open, rocky summit, west side of Abbott Butte, on boundary line between Jackson and Douglas counties, 1650 m. alt., June 29, 1898, *Applegate 2532* (D); dry yellow pine woods, near summit of Little Chinquapin Mt., Jenny Creek Region, Cascade Mts., May 25, 1925, *Applegate 4298* (D, UC); dry, grassy slopes, near Abbott Butte, 2000 m. alt., July 6, 1899, *Leiberg 4238* (UO); summit of Mt. Ashland, July 15, 1913, *Peck 1379* (WU); open ground, summit of Cascade Mts., along Ashland-Klamath Falls Road, July 4, 1920, *Peck 9251* (D, G, M, NY, PA, WU); dry woods, 1 mi. w. of Pinehurst, June 19, 1927, *Peck 15019* (WU).

CALIFORNIA. SISKIYOU CO.: Humbug Mt., May 1, 1910, *Butler 1260* (UC); Shackleford Creek, June 5, 1910, *Butler 1508* (UC); Marble Mt., 2400 m. alt., June, 1901, *Chandler 1646* (D, M, NY, UC); summit, Siskiyou Mts., June 16, 1894, *Howell 296* (G, UO); loose, somewhat rocky soil, open slopes, 2½ mi. n. w. of Dry Lake Lookout, summit of Siskiyou Mts., July 19, 1938, *Ownbey & Ownbey 1748* (CA, Clokey, D, F, G, Kew, M TYPE, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS).

9. Calochortus Lobbii Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 122. 1901, excl. syn.

Calochortus subalpinus Piper in Contrib. U. S. Nat. Herb. **11** [Fl. Wash.]: 195. 1906; Bull. Torr. Bot. Club **33**: 538. 1906.

Bulb ovoid, with membranaceous coats; stem usually scapiform, 0.5–3 dm. tall, erect or flexuous; basal leaf 1–3 dm. long, 2–15 mm. broad, tapering toward both ends, usually equalling or exceeding the stem; inflorescence subumbellate, 1–5(–7)-flowered, bracts 2 to several, lanceolate to linear, acuminate, unequal, 1–5 cm. long; flowers yellowish white, sometimes lavender-tinged, frequently with a narrow purple crescent on each petal above the gland, and usually with a purple, glandular spot near the base of each sepal, erect or spreading on rather slender pedicels which become stouter and strongly deflexed in fruit; sepals shorter than the petals, oblong-lanceo-

late, acute to acuminate, inner face minutely papillose, glabrous; petals broadly obovate, cuneate, obtuse or acute, inner face densely papillose, fringed laterally and moderately bearded nearly to the apex above the gland with long, slender hairs; gland transverse, arched upward, more or less deeply depressed, bordered below with a narrow, ascending, deeply fringed membrane, and above with a narrow, merely crenate membrane, invested toward the upper portion of the enclosed surface with rather long, slender processes, both processes and fringe of the lower membrane densely long-papillose; anthers lanceolate, long-apiculate, usually longer than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, usually acute, 3-winged, nodding; seeds irregular, with pale yellow, hexagonally reticulate coats, and terminal, netted crests.

Calochortus Lobbii is not closely related to any other species of the section EUCALOCHORTUS. In size and habit, it somewhat approaches *C. apiculatus,* but the characters of the gland and the glandular spots on the sepals distinguish it from this and all other species.

DISTRIBUTION. In loose, volcanic soils, southern Washington from the vicinity of Mount Adams and Mount St. Helens, southward in the Cascade Mountains to the region of the Three Sisters in central Oregon.

WASHINGTON. YAKIMA CO.: Klickitat River, June 24, 1899, *Flett 1124* (WS); sandy soil, Signal Peak, S. 25, T. 9 N., R. 13 E., 1200 m. alt., July 3, 1932, *Heidenreich 188* (WS); grassy slopes of Mt. Adams, Aug. 8, 1882, *Henderson 982* (D); Mt. Adams, 1883, *Henderson* (G); North Fork of Tieton River, July 26, 1911, *Hinman* (UCLA); Mt. Adams, Aug. 9, 1894, *Lloyd* (NY); loose soil on mountain slopes, Mt. Paddo (Adams), June, Aug., 1883, *Suksdorf* (F, PA); dry alpine meadows of Mt. Adams, 1500 m. alt., July 30, 1934, *Thompson 11134* (M, NY); moist soil of mountain meadows, Surprise Lake, near Goat Rocks, S. 2, T. 11 N., R. 11 E., east slope of Cascade Mts., 2220 m. alt., Aug. 21, 1936, *Wilcoxon 80* (WS). KLICKITAT CO.: near Trout Lake, base of Mt. Adams, July 10, 1879, *Henderson* (UO); loose sandy soil in open *Pinus ponderosa* forest, along road, about 2 mi. n. of Glenwood, June 18, 1938, *Meyer 1496* (WS); open pine woods, Trout Lake, June, 1923, *Pearson 347* (WS); loose, volcanic soil, Falcon Valley, July 1, Aug., 1881, *Suksdorf* (F, NY). SKAMANIA CO.: Observation Peak Lookout, Columbia National Forest, 1260 m. alt., June 28, 1925, *Ingram 1914* (WS); open, park-like areas, Observation Peak Trail, 1050 m. alt., *Kienholz* (UO); Ice Cave, near Trout Lake, Aug. 5, 1894, *Lloyd* (NY); high mountains, Aug. 11, 1886, *Suksdorf* (G).

OREGON. HOOD RIVER CO.: Cloud Cap Inn, Mt. Hood, 1800 m. alt., July 25–28, 1922, *Abrams 9386* (D, P, RM); Mt. Hood, 1950 m. alt., Aug. 26, 1899,

Barber 230 (G); rich meadows, south side of Mt. Hood, 1800 m. alt., July 3, 1926, *English* (WS); Mt. Hood Region, June, 1920, *Hawver* (CA); alpine glades, Mt. Hood, Aug. 13, 1896, *Henderson* (RM); grassy alpine slopes, Mt. Hood, June, Aug., 1924, *Henderson 810* (G, M); middle elevations, Mt. Hood, Aug., 1891, *Howell & Howell* (UO); Mt. Hood, Aug. 5, 1881, *Howell* (F, G, PA), type collection of *C. subalpinus* Piper; Mt. Hood, Aug., 1889, *Howell* (UO); Mt. Hood, 1500 m. alt., July 31, 1897, *Jones* (P); Mt. Hood, Aug., 1898, *Savage, Cameron & Lenocker* (F, M); dry south slope of Bluegrass Ridge, Mt. Hood, July 31, 1927, *Thompson 3312* (D); Bluegrass Ridge, Mt. Hood, 1500–1650 m. alt., July 22, 23, 1928, *Thompson 5063* (D, G, M, PA); Cloud Cap, Mt. Hood, Summer, 1929, *Van Dyke* (CA); Mt. Hood, Aug. 20, 1866, *Wood 1576* (G). CLACKAMAS CO.: south side of Mt. Hood, 2100 m. alt., July 9, 1931, *Howell 7271* (CA); grassy slopes and banks, above Government Camp, south slope of Mt. Hood, 1800 m. alt., Aug. 18, 1936, *Munz 14450* (D, P, UC, WS); dry ridge, 4 mi. w. of Table Rock, May 30, 1924, *Peck 13219* (PA, WU); Paradise Park, Aug. 4, 1927, *Thompson 3397* (D, WU); Mt. Lowe, July, 1918, *Wash* (UO). WASCO CO.: Barlow Road, near Mt. Hood, July 24, 1894, *Lloyd* (NY); dry hillside, near White River, Mt. Hood, 1050 m. alt., July 23, 1928, *Thompson 5011* (D). MARION CO.: Jefferson Park, Aug. 9, 1933, *Leach* (WU); top of House Mt., May 31, 1926, *Peck 14641* (WU); dry slope, 4 mi. s. e. of Breitenbush, *Peck 16228* (WU); dry slope, 2 mi. s. of Breitenbush Lake, Aug. 10, 1935, *Peck 18780* (WU); very dry south slope, Jefferson Park, S. 11, T. 10 S., R. 8 E., Mt. Jefferson Primitive Area, Aug. 13, 1936, *Peters 197* (WS); Mt. Jefferson, Aug., 1897, *Purdy* (Kew), TYPE COLLECTION. JEFFERSON CO.: loose soil, open pine-larch forest, 1 mi. s. of Camp Sherman, near the source of the Metolius River, July 29, 1938, *Ownbey & Ownbey 1799* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); dry talus slope about Harvey Lake, Aug. 13, 1935, *Peck 18837* (WU), *18837a* (WS). LANE CO.: summit of Horse Pasture Mt., June 16, 1934, *Andrews 436* (UO); McKenzie Pass, Skyline Trail, 2 mi. from Frog Camp, July 1, 17, 1934, *Andrews* (UO); rocky ridges above Benson Lake, western side of the Cascade Summit, near McKenzie Pass, July 11, 1924, *Constance* (UC); sunny, loose soil, McKenzie Pass, July 28, 1934, *Henderson* (UO); dry, open, loose soil, McKenzie Pass, July 28, 1935, *Henderson 17581* (UO); south side of Jackass Ridge, Bohemia Mt., 1650 m. alt., Aug. 9, 1927, *Henderson & Patterson 14226* (PA, UO); very loose soil, borders of meadows and edge of coniferous woods, 5½ mi. w. of McKenzie Pass, July 27, 1938, *Ownbey & Ownbey 1797* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS,); summit of Cascade Mts., along McKenzie Pass 1700 m. alt., July 11, 1914, *Peck 3200* (WU); summit of Horse Pasture Mt., 10 mi. s. of McKenzie Bridge, 2000 m. alt., July 1, 1914, *Peck 3201* (G, WU); dry ground along McKenzie Pass, 7 mi. w. of summit of Cascade Mts., Aug. 7, 1920, *Peck 9807* (D, G, M, NY, PA, WU); Castle Rock, near Three Sisters, June 10, 1903, *Sweetser* (UO). DESCHUTES CO.: Island Meadows, 3 mi. w. of Elk Lake, June 27, 1934, *Andrews* (UO); headwaters of Deschutes River, Aug. 16, 1897, *Coville & Applegate 550* (D).

10. Calochortus apiculatus Baker in Journ. Linn. Soc. Lond. Bot. **14**: 305. 1874.

Bulb ovoid, with membranaceous coats; stem usually scapi-

form, 1–3 dm. tall, usually stout and erect; basal leaf 1–3 dm. long, 5–15 mm. broad, tapering toward both ends, usually shorter than the stem; inflorescence subumbellate, 1–5-flowered, bracts 2 to several, lanceolate to linear, acuminate, unequal, 1–5 cm. long; flowers yellowish white, sometimes pencilled with purple, erect or spreading on rather stout pedicels which become strongly deflexed in fruit; sepals shorter than the petals, oblong-lanceolate, acute to acuminate, inner face minutely papillose below, glabrous; petals obovate to oblanceolate, acute or obtuse, clawed, inner face densely papillose, fringed laterally and moderately bearded on the lower half above the claw with slender, more or less flexuous hairs; gland small, depressed, nearly circular in outline, bordered below with a dark-colored, deeply fringed membrane, which may be lacking, surface covered with short, thick processes, uniformly scattered or aggregated at the upper margin; anthers lanceolate, long-apiculate, equalling or exceeding the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute, 3-winged, nodding; seeds irregular, with light brown, hexagonally reticulate coats.

Calochortus apiculatus is easily separated from all other species of the subsection ELEGANTI by its small, nearly circular, dark-colored gland.

DISTRIBUTION. Dry, rocky slopes in open, coniferous woods, southwestern Alberta and adjacent northwestern Montana, westward to British Columbia and northeastern Washington.

ALBERTA. Waterton Lake, July 28, 1895, *Macoun 13813* (G, NY); Crows Nest Pass, Lat. 49° 30′, Aug., 1897, *Macoun 25049* (NY).

BRITISH COLUMBIA. Mountain sides, woods, Creston, Kootenay Co., July 12, 1917, *Anderson* (WS).

MONTANA. GLACIER CO.: Grinnell Lake, Glacier Park, July 13, 1923, *Hollis & Hollis 5724* (M, UCLA); moist woods near Cutbank Creek, Glacier National Park, July 15, 1934, *Jones 5489* (UC); on open rocky slopes, trail to Grinnell Glacier, Glacier National Park, July 28, 1928, *Peirson 8093* (UC); Blackfeet Indian Reservation, Aug., Sept., 1909, *Thompson* (NY); hills, Midvale, June 16–18, 1903, *Umbach 104* (D, F, NY, RM); Two Medicine Lake, Glacier National Park, July 2, 1930, *Van Dyke* (CA); Lake St. Marys, Glacier National Park, July 3, 1930, *Van Dyke* (CA). FLATHEAD CO.: Olney, July 12, 1937, *Bachert 11* (UM); Whitefish, June 8, 1937, *Bachert 613* (UM); Whitefish Flat, July 9, 1937, *Bohinger 24* (UM); Big Fork, July 14, 1908, *Butler 925, 926* (NY); MacDougal, July 3, 1908,

Butler 992 (NY); MacDougal Peak, July 30, 1908, *Butler 3029* (NY); MacDougal Peak, vicinity of Flathead Lake, July 31, 1908, *Clemens* (D, F, M); Kalispell, 900 m. alt., June 8, 1937, *Harding 873* (UM); alpine meadow, on ridge directly n. of Hidden Lake, Glacier National Park, 2400 m. alt., July 26, 1933, *Hitchcock 1900* (P, UM); alpine, MacDougal Peak, Flathead Lake, 1950 m. alt., July 30, 1908, *Jones 9213* (P, UM); Daphnia Lake, Big Fork, 870 m. alt., July 18, 1908, *Jones 9214* (P); MacDougal Peak, Flathead Lake, 1200 m. alt., July 30, 1908, *Jones 9215* (P); Big Fork, June 15, 1904, *Jones* (G, UC); Elk Mt., near Kalispell, Blackfeet National Forest, *Krukoff* (NY); Red Meadow Creek, North Fork of Flathead River, June 15, 1928, *Lemmon* (UM); Big Fork, 1000 m. alt., July 9, 1901, *MacDougal 584* (NY, UM); MacDougal Peak, 1700 m. alt., Aug. 2–10, 1901, *MacDougal 839* (NY, UM); open woods, Snyder Creek, Glacier National Park, June 18, 1926, *St. John 4852* (WS); slopes of Kootenai Mts., Big Fork, Aug. 11, 1901, *Umbach 76* (F, NY, PA); Glacier Basin, below Sperry Glacier, 1800–1950 m. alt., Aug. 5, 1901, *Vreeland 1052* (NY); Columbia Falls, June 24, 1894, *Williams 635* (G, M, NY, RM, UM); in open woods along Camas Creek, 1050 m. alt., July 11, 1937, *Yuncker & Yuncker 6797* (F). LEWIS AND CLARK CO.: woodlands, near headwaters of Blackfoot River, July 14, 1883, *Canby 325* (G); woodlands, along Clear Creek, July 13, 1881, *Canby 325* (PA); Priests Pass, Helena, July, 1892, *Starr* (M); North Fork of Sun River, Aug. 1887, *Williams 635* (F, G). LAKE CO.: dry roadside, Biological Station, east shore of Flathead Lake, June 15, 1938, *Barkley & Reed, 2626A, 2626B* (G, M, O); Flathead Lake, 1050 m. alt., June 14, 1937, *Fluto 884* (UM); Yellow Bay, June, 1913, *Kirkwood* (Clokey). POWELL CO.: Pinewood, Aug., 1902, *Burns 89* (RM). MISSOULA CO.: mountain woods, Missoula, July, 1923, *Burtness* (Clokey); Rattlesnake Creek, July, 1916, *Hughes* (UM); Evaro, 1200 m. alt., July 13, 1909, *Jones* (P); open woods, benches, Grant Creek, near Missoula, July 4, 1922, *Kirkwood 1053* (M, UM); Johnston Gulch, Bonner, June 14, 1925, *Maclay* (UM); Rattlesnake Creek, n. of Missoula, May 22, 1935, *Rose 169* (O, UM); Rattlesnake Creek, n. of Missoula, June 15, 1937, *Rose 484* (O); Sunset, 1901, *Scheuber 256* (NY); Granite Canyon, near Missoula, Aug. 5, 1881, *Watson 420* (G). LINCOLN CO.: rocky hillside, Zeigler Mt., T. 33 N., R. 28 W., 1620 m. alt., July 8, 1928, *Snow* (WS). COUNTY NOT DETERMINED: near Teddy, Lewis and Clark Forest, July 7, 1937, *Kramer 19* (UM); woods, Sin-yale-a-min Lake, 1000 m. alt., June 18, 1901, *MacDougal 303* (NY, UM).

IDAHO. BONNER CO.: hillside, Hope, May 18, 1914, *Dunkle 426* (RM); in woods along trail, 2 mi. below Priest River Experiment Station Lookout, July 19, 1928, *Ellison* (UCLA); open places, roadsides, Priest River Experiment Station, 750 m. alt., July, 1923, *Epling 5725* (F, M, UCLA); Hope, July, 1929, *Epling* (UCLA); near lower end of Priest Lake, 600 m. alt., July 26, 1900, *MacDougal 151* (NY); Priest Lake, Aug., 1901, *Piper 3777* (WS); near Coolin, Aug. 10, 1923, *Piper* (WS). SHOSHONE CO.: in limestone talus on open southwest slopes of Grizzly Peak, n. of Coeur d'Alene River, Coeur d'Alene National Forest, S. 3, T. 51 N., R. 3 E., July 3, 1938, *Sharsmith 3592* (G, M, O). KOOTENAI CO.: in open places, Coeur d'Alene, June 12, 1909, *Johnson 147* (RM); dry ground, south end of Lake Pend Oreille, 610 m. alt., June, 1889, *Leiberg* (M, UO); ridges s. from Wiessners Peak, region of Coeur d'Alene Mts., 2000 m. alt., July 26, 1895, *Leiberg 1370* (RM, UO); sand plain, Coeur d'Alene, June 17, 1927, *St. John 8264* (WS);

rich woods, near Farmington Landing, Lake Coeur d'Alene, July 2, 1892, *Sandberg, MacDougal & Heller 532* (CA, D, G, NY, PA, UC); 1½ mi. n. of Hayden Lake, May 29, 1925, *Smith* (WS). COUNTY NOT DETERMINED: near log chute from Fox Creek into Big Creek, Kaniksu Forest, June 16, 1928, *Ellison* (UCLA); Roman Nose Mt., Pend Oreille Forest, July, 1929, *Epling* (UCLA).

WASHINGTON. STEVENS CO.: Biglow Gulch, July 3, 1923, *Large 46* (D, WS). SPOKANE CO.: Liberty Lake, June 3, 1919, *Kienholz* (WS); Spokane, *Reed* (WS). STATE NOT DETERMINED. Hills, Pend Oreille and Kootenay rivers, June, 1861, *Lyall* (G, Kew TYPE; G, NY, PA, WS, photographs of type).

Subsection 3. NUDI.[28]

Flowers campanulate, erect or spreading; petals obovate, cuneate, not fringed, glabrous or nearly so; stems scapiform or leafy, branched in one species; fruits elliptic, 3-winged, usually nodding.

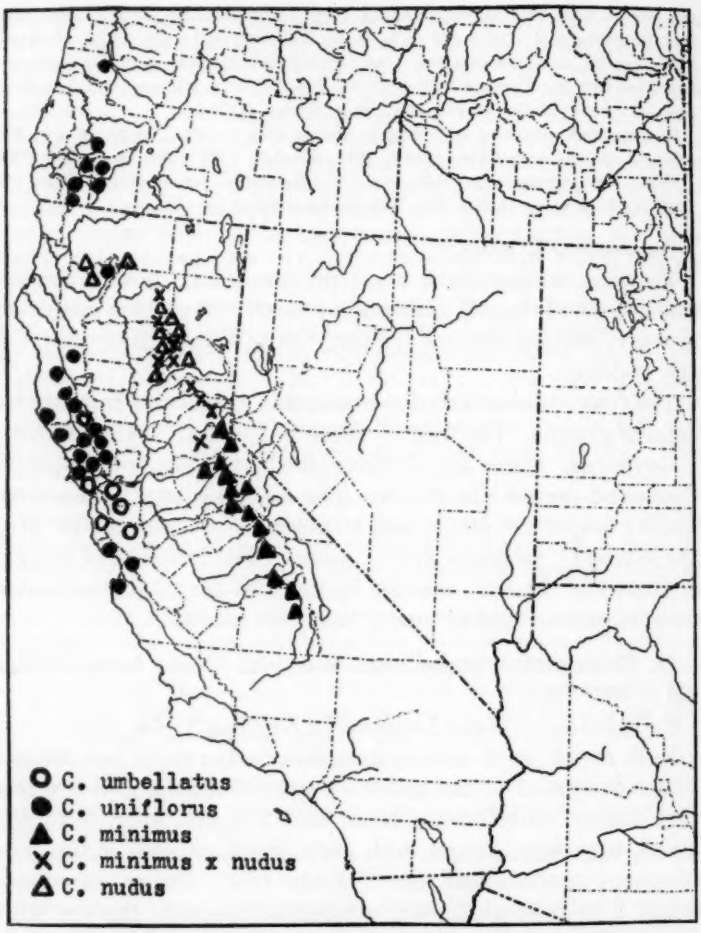
The four species included under this subsection fall into two natural groups. The first of these includes *C. umbellatus* and *C. uniflorus,* which are distinguished by their non-scapiform stems and pocket-like glands. The second group is characterized by scapiform stems and straight or arched glands. Here are placed *C. minimus* and *C. nudus.* The latter is of interest in that it is the only species in the first three subsections of EUCALOCHORTUS that normally has erect capsules.

11. Calochortus umbellatus Wood in Proc. Acad. Philad. [20]: 168. 1868.

Calochortus collinus Lemmon in Erythea 3: 49. 1895.

Bulb ovoid, with membranaceous coats; stem low, usually 2-branched, each of the branches subumbellately 2–6-flowered, very rarely bulbiferous; basal leaf 2–4 dm. long, 5–15 mm. broad, tapering toward both ends, much exceeding the inflorescence; cauline leaf one (rarely two), linear, attenuate; bracts 2 to several, linear, attenuate, unequal; flowers white or pale lilac, often with a purple spot on each petal near the gland and a similar spot near the base of each sepal, erect or spreading on slender pedicels which become strongly recurved in fruit; sepals shorter than the petals, elliptic-lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, rounded

[28] NUDI subsect. nov., floribus campanulatis erectis aut patentibus; petalis obovatis cuneatis non fimbriatis glabris aut subglabris; caulibus scapiformibus aut foliatis, in una specie ramosis; capsulis ellipticis 3-alatis plerumque cernuis.



Map 3. Distribution of the species and hybrids of the subsection NUDI.

and erose above, not ciliate, inner face with a few slender hairs near the gland, otherwise naked or nearly so; gland convex basally, truncate above, covered with a broad, ascending membrane which is fringed at its upper margin, bordered above with a row of short processes, the enclosed surface naked; anthers oblong, obtuse or acute, shorter than the basally dilated

filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse, 3-winged, nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

Calochortus umbellatus is closely allied to *C. uniflorus*, but is easily distinguished from that species by its smaller, more numerous flowers, taller, branched stem, shorter pedicels and almost complete lack of bulblets. Their habitats are also very distinct; *C. umbellatus* is found on hillsides, whereas *C. uniflorus* prefers low, wet meadow lands.

DISTRIBUTION. California: Coast Ranges from Lake County to Santa Clara County, particularly abundant on the hills about San Francisco Bay.

CALIFORNIA. LAKE CO.: mountain, near Kelseyville, April, 1901, *Bowman* (D). MARIN CO.: Pipeline Trail, ½ mi. e. of Rattlesnake Camp, Mt. Tamalpais, April 29, 1922, *Abrams 8082* (D); 1½ mi. below Western Peak, Mt. Tamalpais 480 m. alt., *Bacigalupi* (D); between Mill Valley and Redwood Canyon, April, 1904, *Baker* (UC); Mt. Tamalpais, Feb. 26, 1900, *Chandler 482* (UC); Mt. Tamalpais, Feb. 22, 1901, *Chandler 750* (UC); road to Muir Woods, Mill Valley, April 8, 1913, *Condit* (UC); Big Carson Ridge, June 7, 1925, *Eastwood 12981* (CA); in chaparral, Mt. Tamalpais, April 20, 1917, *Grant 927* (D, NY); Pipeline Trail, April 5, 1925, *Howell 905* (CA); Mill Valley, April 28, 1917, *Mason* (Clokey); on ridges above Muir Woods, April, 1926, *Parks* (D, F, M, NY, P, UC); Eastwood Place, Mt. Tamalpais, May 6, 1923, *Sutliffe* (CA). CONTRA COSTA CO.: Walnut Creek, s. of Camp 69, May 1, 1862, *Brewer 1035* (UC); San Pablo Hills, March 24, 1900, *Hall* (UC); hills e. of St. Mary's College, May 14, 1933, *Howell 11261* (CA). ALAMEDA CO.: near Lake Temescal, April, 1891, *Bioletti* (Kew, UC); Oakland Hills, April, *Bolander* (D, G, NY); near Mountain View Cemetery, April 3, 1890, *Cannon* (CA); Oakland Hills, March, 1900, *Carruth* (CA); head of Long Canyon, e. of Oakland, May 9, 1891, *Chesnut & Drew* (UC); under brush and in open, northeast end of Redwood Ridge, March 4, 1932, *Constance 333* (UC); Laundry Farm, *Dunn* (G); Laundry Farm, April, 1894, *Eastwood* (UC); Grizzly Peak, Berkeley, May 10, 1907, *Eastwood* (CA); Berkeley, April 15, 1895, *Jepson* (D, M); on open, grassy hillside, Claremont Canyon, in hills back of Berkeley, April 3, 1920, *Johnston* (P); Berkeley, March 14, 1914, *Jones 46* (G); Laundry Farm, March 14, 1917, *Kelley* (CA); Oakland Hills, April, 1878, *Kellogg* (D); at Thompson's, San Antonio Creek, April 18, 1868, *Kellogg & Harford 1003, in part* (CA, G); near Lake Chabot, May, 1895, *Merrill* (P); Berkeley, April 24, 1892, *Michener & Bioletti 2121* (NY, UC); Oakland, *Purdy* (F, G); Laundry Farm, *Purdy* (UC); Oakland Hills, *Purdy* (UC, type of *C. collinus* Lemmon); North Berkeley, April 27, 1914, *Shuquist* (UC). SAN MATEO CO.: Belmont, June 17, 1893, *Davy 795* (UC). SANTA CLARA CO.: steep hill-slope above Santa Isabella Creek, northern base of Mt. Hamilton, 525 m. alt., March 30, 1934, *Sharsmith 672* (WS); edges of chaparral, western canyon slope of Long Branch Creek, southeast end of Mt. Day Ridge, Mt. Hamilton Range, 720 m. alt., May 4, 1935, *Sharsmith 3026* (O).

12. Calochortus uniflorus Hooker & Arnott, Bot. Beechey's Voy. p. 398, *t. 94.* 1841; J. D. Hooker in Bot. Mag. Ser. III. **25**: *t. 5804.* 1869.

Cyclobothra uniflora Kunth, Enum. Pl. **4**: 669. 1843.

Calochortus lilacinus Kellogg in Proc. Calif. Acad. **2**: 5. 1863.

Bulb ovoid, with membranaceous coats; stem very short, barely reaching above the surface of the ground, usually not branched, bulbiferous in the axils of the cauline leaves, subumbellately 1–5-flowered; basal leaf 1–4 dm. long, 5–20 mm. broad, tapering toward both ends, much exceeding the inflorescence; cauline leaves 1 to 3, linear, attenuate, reduced upward; bracts 2 to several, linear, attenuate, unequal; flowers lilac, often with a purple spot on each petal about the gland, erect on very long pedicels which usually become characteristically recurved in fruit; sepals shorter than the petals, elliptic-lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, rounded and erose-denticulate above, occasionally with a few inconspicuous hairs on the lateral margins and usually with a few hairs in the vicinity of the gland, otherwise naked or nearly so; gland convex basally, truncate above, covered with a broad, ascending membrane which is fringed at its upper margin, bordered above with a row of slender processes, the enclosed surface naked; anthers oblong, obtuse or acute, shorter than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit oblong, obtuse, narrowly 3-winged, usually nodding; seeds irregular, with dark brown, hexagonally reticulate coats.

This species is easily distinguished by its bulbiferous habit, short stem and long pedicels.

DISTRIBUTION. In low meadow lands, southwestern Oregon and southward to Monterey County, California.

OREGON. LANE CO.: swale banks, moist, sunny roadsides, about 7 mi. n. w. of Eugene, April 16, 1934, *Henderson 16224* (UO, WU); meadow, 6 mi. n. w. of Eugene, April 16, 1934, *Rose 34206* (CA). DOUGLAS CO.: Canyonville, April, 1881, *Howell* (F, PA). JACKSON CO.: Queens Branch, near Wimer, May 17, 1892, *Hammond 390* (M, NY, UO); Woodville, May 16, 1890, *Howell* (PA). JOSEPHINE CO.: dry ground, 4 mi. s. of Waldo, May 19, 1928, *Gale 247* (D, M); moist meadows,

Merlin, May 7, 1887, *Henderson 1378* (G, UO); grassy borders of wet meadows, Grants Pass, May 10, 1887, *Henderson* (UO); Grants Pass, May 27, 1887, *Henderson* (UO); wet, rocky, red-clay flat, base of Eight Dollar Mt., near Selma, April 14, 1926, *Henderson 5988* (CA, D, M, RM, UO); moist, disintegrated granite, New Hope Road, June 8, 1930, *Henderson 12785* (UO); Grave Creek, May 21, 1884, *Howell* (G); in wet meadows, Grants Pass, May, 1884, *Howell 295* (UO); Grants Pass, May 12, 1885, *Howell 1396* (M, NY, UC, UO); meadow, near Waldo Junction, May 18, 1930, *Kildale & Kildale 9591* (D); Grants Pass, June 10, 1904, *Piper 6282* (G); pasture, Grants Pass, May 4, 1912, *Prescott* (F, G, WU); moist, subwooded flats, Grants Pass, May 3, 1906, *Sweetser* (PA).

CALIFORNIA. TRINITY CO.: Preacher Meadow, June 25, 1937, *Eastwood & Howell 4930* (CA); Carrville, *Reynolds* (CA). MENDOCINO CO.: Ukiah, 1866, *Bolander 4666* (F, M); swamps, Long Valley, 1866, *Bolander 4710* (G, UC); Sherwood Valley, June 17, 1899, *Dudley* (D); 6 mi. s. of Point Arena, May 31, 1937, *Eastwood & Howell 4483* (CA, NY); Ukiah, May 8, 1869, *Kellogg* (D); Ukiah, April, 1881, *Purdy* (G); Ukiah, *Purdy* (F, G, UC); Round Valley, 1898, *Westerman* (UC). LAKE CO.: wet places, Siegler Springs, April 29, 1923, *Blankinship* (CA); low woods, Siegler Springs, April 30, 1929, *Blankinship* (M); near Adams Springs, May 18, 1938, *Eastwood & Howell 5764* (CA); Piner's pasture, vicinity of Kelseyville, April 12, 1904, *Irwin 64* (UC); Kelseyville, April 1, 1931, *Jussel 93* (CA); Jordan Park, Coleman Estate, April 30, 1932, *Jussel* (CA); Four-Mile Grade, open meadow near Mendocino County Line, June 5, 1933, *Lodge 379* (UC); 2 mi. n. of Middletown, May 4, 1928, *Wolf 1897* (D). NAPA CO.: damp adobe meadow opposite Myrtledale Geyser, 1½ mi. n. of Calistoga, March 27, 28, 1926, *Bacigalupi 1249* (D, G, NY, P); meadows, Calistoga, April 19, 1903, *Baker 1979* (CA, F, G, M, NY, P, RM, UC); Calistoga Geyser, April 23, 1927, ex herb. *Baker 2202a* (D); Calistoga, June 5, 1915, *Eastwood 4632* (CA); Calistoga, May 2, 1918, *Eastwood 6879* (CA, Clokey); Calistoga, April 20, 1892, *Greene* (UC); Myrtledale Hot Springs, near Calistoga, March 27, 1926, *Howell 1757* (CA); St. Helena, April 1, 1921, *Hunt* (CA); salt marsh, near Calistoga, May 2, 1893, *Jepson* (UC); Conn Valley, *Jepson 6254* (G); in alkaline field, geysers just n. w. of Calistoga, 110 m. alt., April 4, 1931, *Keck 1097* (D, G, M, P, PA, UC). SONOMA CO.: between Stewarts Point and Sea View, April 5, 1898, *Baker* (UC); Sonoma Valley, near Santa Rosa, April, 1899, *Baker* (UC); Sonoma, *Bioletti* (UC); in meadow, Mark West, 1864, *Brewer 3960* (UC); Santa Rosa, April 24, 1921, *Eastwood 10336* (CA). MARIN CO.: Lake Lagunitas, May 11, 1918, *Campbell* (CA); Lagunitas, April 28, 1918, *Grinnell* (D). SANTA CRUZ CO.: Soquel Point, April 27, 1902, *Thompson* (D). SAN BENITO CO.: Aromas, April 6, 1915, *Eastwood 4186* (CA). MONTEREY CO.: Monterey, 1889, ex herb. *Abbott* (CA, NY); pine woods near Cypress Point, Monterey, May 22, 1860–62, *Brewer 656* (G); woods, Monterey, May 12, 1901, ex herb. *Congdon* (D); locality uncertain, but presumably near Monterey, "California," *Douglas* (G, NY), TYPE COLLECTION; grassy meadows, April 14, 1894, *Dudley* (D); pine woods, Pacific Grove, May 16, 1903, *Heller 6729* (D, F, G, NY, P, PA, RM, UC, UO); Monterey, March, 1868, *Kellogg & Harford 1003, in part* (M, NY); vicinity of reservoir, Pacific Grove, July 6, 1906, *McGregor 50* (D); Monterey, 1850, *Parry* (NY); back of Pebble Beach Lodge, 17-Mile Drive, March 28, 1910, *Randall 155* (D); in field, off road to Point Lobos, April 17, 1910, *Randall* (D); near Pebble Beach, 17-Mile Drive, April 30, 1910, *Randall 417* (D).

13. Calochortus minimus Ownbey, n. sp.[29]

Calochortus elegans var. *subclavatus* Baker in Proc. Linn. Soc. Lond. Bot. **14**: 305. 1874.

Bulb ovoid, with membranaceous coats; stem scapiform, low, usually reaching only to the surface of the ground, subumbellately 1–3(–10)-flowered; basal leaf 1–2 dm. long, 3–10 mm. broad, usually greatly exceeding the inflorescence; bracts usually 2, opposite, lanceolate, acuminate, unequal, 1–2(–6) cm. long; flowers small, white, erect or spreading on slender pedicels which become strongly deflexed in fruit; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals obovate, cuneate, usually acute, erose-denticulate above, not ciliate, naked or with a few slender hairs near the gland; gland transverse, straight, surface naked, not depressed, bordered below with a broad, ascending, laciniate or fringed membrane, the margin of which is minutely papillose; anthers linear-oblong, acute, about equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, obtuse, 3-winged, nodding; seeds irregular, with hexagonally reticulate coats.

Specimens of *C. minimus* were included under *C. nudus* by Watson, but the original description of that species was drawn from specimens collected in Plumas County by Mrs. R. M. Austin. Purdy interpreted the plant here described as *C. nudus,* and proposed the name *C. shastensis* for the more northern species. This interpretation has been followed by

[29] **Calochortus minimus** sp. nov., bulbo ovoideo membranaceo-tunicato; caule scapiformi humili plerumque perveniente tantum usque ad summam terram, subumbellate 1–3(–10)-floro; folio basali 1–2 dm. longo, 3–10 mm. lato, plerumque inflorescentiam multo superante; bracteis plerumque 2, oppositis lanceolatis acuminatis inaequalibus, 1–2(–6) cm. longis; floribus parvis albis erectis aut patentibus in pedicellis gracilibus et fructu insigniter deflectentibus; sepalis petalis brevioribus lanceolatis acuminatis glabris; petalis obovatis cuneatis plerumque acutis apice eroso-denticulatis non ciliatis glabris aut paucis pilis gracilibus prope glandulam; glandula transversa recta, superficie nuda, non depressa, subter membrana lata adscendente laciniata aut fimbriata marginata, cuius margo minute papillosus est; antheris lineari-oblongis acutis filamentis basilariter dilatatis subaequilongis; ovario 3-alato, stylo brevi, stigmate persistente trifido; capsula elliptica obtusa 3-alata cernua; seminibus irregularibus testis hexagono-reticulatis.

later writers, apparently without consulting either Watson's specimens or his original description.

C. minimus is the smallest of the *Calochorti*. It is very uniform throughout the range here given, but northward it has hybridized with *C. nudus* to such an extent that it can be said to occur there only as *minimus*-like individuals. Since *C. nudus* is its dominant element, this hybrid population is included under that species, where it is more fully discussed.

DISTRIBUTION. California: in open coniferous woods, eastern Eldorado County, southward in the Sierra Nevada to Tulare County.

CALIFORNIA. ELDORADO CO.: Grass Lake, near Lake Tahoe, July 17, 1904, *Baker* (UC); Lake Lucille, Glen Alpine Region, July 25, 1906, *Eastwood 1027* (CA); Fallen Leaf, trail via Lake of Woods to Desolation Valley, July 10, 1920, *Ehlers 882* (UC); near Forni, Pyramid Peak, 2190 m. alt., Aug. 1, 2, 1903, *Hall & Chandler 4754* (UC); near Velma Lakes, on trail to Eagle Lake, Lake Tahoe Region, June 28, 1925, *Howell 1238* (CA); Velma Lakes, Lake Tahoe Region, July 22, 1928, *Jussel* (CA); very damp soil, in the woods near Grass Lake, near Glen Alpine Spring, July 19, 1909, *Lathrop* (D); Wrights Lake, July 7, 1935, *Lillard* (P); Grass Lake, Aug. 8, 1909, *McGregor 6* (D, NY); Desolation Valley, 2250 m. alt., Aug. 18, 1909, *McGregor 163* (D, NY); Grass Lake Trail, 2070 m. alt., July 23, 1907, *Pendleton & Reed 1028* (UC); Grass Lake Trail, Glen Alpine, 2100 m. alt., July 23, 1907, *Pendleton & Reed 1073* (UC); Glen Alpine, vicinity of Lake Tahoe, 1860–2700 m. alt., July 6–21, 1901, *Setchell & Dobie* (UC); Lake of the Woods, meadow near lake shore, 2430 m. alt., July 15, 1913, *Smiley 58* (G). CALAVERAS CO.: Big Trees, June, 1874, *Edwards* (NY); "Calaveras," Aug., 1883, *Meehan* (PA); Big Trees, May 15, 1887, *Smith* (PA); near Dunbar Crossing, May 21, 1923, *Steinbeck* (CA); in open yellow pine forest, near Avery, 1140 m. alt., May 23, 1921, *Tracy 5763* (UC). TUOLUMNE CO.: Peach Growers Mill, Middle Fork of Tuolumne River, about 2 mi. s. of Mather, May 9, 1926, *Bacigalupi 1448* (D TYPE, NY, P); Hetch-Hetchy Valley, June, 1900, *Bioletti* (UC); North Fork Griswold Creek, near Grizzly Meadows, Stanislaus National Forest, June 1, 1934, *Quick 1264* (CA); Cow Creek, 1890 m. alt., June 10, 1937, *Quick 1804* (CA); Sequoia, June, 1906, *Saunders* (CA); in wet meadow, Tioga Road, near Dark Hole, 2310 m. alt., Aug. 23, 1916, *Smiley 881* (C); marshy meadow near Aspen Valley, Tioga Road, 1920 m. alt., Aug. 24, 1916, *Smiley 908* (G); Pinecrest Recreation Area, Stanislaus National Forest, 1780 m. alt., June 8, July 29, 1934, *Wiggins 6794* (D). MARIPOSA CO.: near Stoneman Orchard, Yosemite Valley, 1200–1350 m. alt., June 19, 1911, *Abrams 4389* (D, G, NY, P); Glacier Point, Yosemite Valley, July, 1902, *Camp* (D); Fatman Mt., May 13, 1894, ex herb. *Congdon* (UC); Big Tree Grove, June 15, 1894, *Dudley* (D); back of Glacier Point, Yosemite, 1872, *Gray* (G); low ground, Yosemite Valley, 1230 m. alt., June 7, 1911, *Hall 8878* (UC); moist, shady place, Chilnualna Fall Trail, Wawona Valley, 1650 m. alt., May 27, 1923, *Howell 27* (CA); near Glacier Point, Yosemite Valley, June 30, 1913, *Kennedy 3002* (CA); near Yosemite Valley, 1875, *Muir 813* (M, PA); Camp Curry, Yosemite Valley, May 23, 1915, *Stone*

(PA); Mariposa Big Trees, Yosemite National Park, June 13, 1894, *Tompkins* (D). MADERA CO.: Shut Eye Pass, Sierra National Forest, 1950 m. alt., July 15, 1912, *Abrams 4941* (D); moist granitic sand, under *Pinus* and *Populus*, edge of North Fork of Willow Creek at Lower Soquel Meadows, near Kelty Meadows, above Sugar Pine, Sierra Nevada, 1500 m. alt., June 20, 1938, *Constance 2373* (O); Mt. Raymond, head of Big Creek, July 13, 1901, *Dudley* (D). FRESNO CO.: Pine Ridge, 1650 m. alt., June 15–25, 1900, *Hall & Chandler 177* (D, M, NY, PA, UC); Balanced Rock Trail, General Grant National Park, July 4, 1927, *Jussel* (CA). TULARE CO.: Sequoia National Park, 1920 m. alt., June 29, 1929, *Anderson* (UCLA); near Mineral King, Sierra Nevada, Aug. 3, 1891, *Coville & Funston 1447* (G); Hockett Meadows, July 14, 1904, *Culbertson 4219* (CA, F, G, M, NY, P, UC); granite slopes of Mt. Silliman, 3000 m. alt., July 5, 1928, *Derby* (CA); vicinity of Camp Alta, region of Tule-Little Kern Divide, 2700–3000 m. alt., July 31, 1895, *Dudley 993* (D); north ravine, Mt. Silliman, 3320 m. alt., July 29, 1896, *Dudley 1507* (D); granitic soil, trail s. of Calison Cabin, vicinity of Homers Nose, region of Sequoia National Forest, 2700 m. alt., July 13, 1897, *Dudley 1814* (D); in grass beneath pines, Hockett Meadows, 2550 m. alt., Aug. 5, 1904, *Hall & Babcock 5641* (UC); Kaweah River Basin, June 30, 1901, *Hopping 40* (UC); near Wielan Creek, Sequoia National Park, June 29, 1931, *Larson* (CA); open woods, Middle Tule River, 2100–2400 m. alt., June, 1896, *Purpus 1786* (UC). COUNTY UNCERTAIN: "California," 1857, *Lobb 243* (Kew).

14. Calochortus nudus Watson in Proc. Am. Acad. **14**: 263. 1879, excl. syn.

Calochortus shastensis Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 125. 1901.

Calochortus nudus var. *shastensis* Jepson, Fl. Calif. **1**: 301. 1921.

Bulb ovoid, with membranaceous coats; stem erect, scapiform, 5–15 cm. tall, subumbellately 1–3(–6)-flowered; basal leaf 1–2 dm. long, 5–15 mm. broad, tapering toward both ends, usually much exceeded by the inflorescence; bracts usually 2, opposite, lanceolate, acuminate, unequal, 1–2(–5) cm. long; flowers erect, white to pale lavender; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, rounded and erose-denticulate above, not ciliate, naked or occasionally with a few slender, flexuous hairs near the gland; gland transverse, straight or arched upward, surface naked, not depressed, bordered below with a broad, ascending, fringed membrane, the fringe minutely papillose; anthers linear-oblong, obtuse or acute, about equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic,

acute at both ends, 3-winged, erect; seeds irregular, with light brown, hexagonally reticulate coats.

The above description was drawn from a considerable series of specimens from the vicinity of Mount Shasta, where the species is remarkably uniform. The specimens on which Watson based his original description were collected in Plumas County and are essentially the same. The name, *C. nudus,* however, has been generally associated with the preceding species, an interpretation which could be justified only by disregarding Watson's description and applying the name to the Yosemite specimen which he cites first, but does not describe.

In the vicinity of Mount Shasta, *C. nudus* is uniform, but south of the Pit River it occurs in pure stand with decreasing frequency as one passes southward. In eastern Eldorado County and southward, only the closely related *C. minimus* occurs. Between the two geographically, there is a bewildering assortment of plants showing independent recombination of the various morphological characters which separate these two species. Such a population can be explained only as the result of long-continued hybridization and probably repeated backcrossing, particularly with *C. nudus.* Pure *C. minimus* does not seem to occur within the area, so the entire population is here referred to *C. nudus.* It should be pointed out, however, that occasional specimens are so close to *C. minimus* that they can be distinguished only by geographical criteria.

From the evidence at hand, it appears that at one time these species were separated by a geographical barrier which allowed evolution to proceed in different directions on either side. As a result there was developed a robust northern race, with larger flowers, rounded petals, taller stems, proportionately shorter and broader basal leaves, and erect fruits which are acute at both ends. It is fortunate that this race has persisted in a nearly pure state in the Mount Shasta Region, and at numerous stations in the northern Sierra Nevada.

The southern race is smaller in all respects, the petals acute, the stems very short, the basal leaves greatly exceeding the inflorescences, the fruits obtuse and nodding on slender, strongly

deflexed pedicels. This race now occupies the southern Sierra Nevada, from eastern Eldorado County southward to Tulare County, in a practically pure condition. The combinations of morphological criteria which separate the southern from the northern race are certainly of specific value. It is only when the intervening population is considered that there is any possibility of another interpretation.

Today the barrier which once separated these two species has disappeared, and they have come together again. Since they were presumably derived from the same stock, the hybrids are fertile and interbreed both among themselves and with both parent species. The result should be a population possessing the characters of both parents, but in different combinations. This is exactly what we find. It is impossible to separate such a population completely into two, or even a dozen, categories, yet the morphological differences between *C. nudus* and *C. minimus* do not permit their inclusion within a single species. Even if such an assignment were possible, it would be undesirable, as it would obscure their probable genetic relationships.

It is of interest to note that this hybrid population occupies almost the identical geographical region, as does the cytologically demonstrated amphidiploid *Penstemon neotericus* Keck. Furthermore, the distributions of the parent species are, in both cases, strikingly similar.

DISTRIBUTION. California: in low meadows and in the coniferous woods about their margins, vicinity of Mount Shasta southward to western Eldorado County.

CALIFORNIA. SISKIYOU CO.: South Fork of Salmon River, 1500 m. alt., July 16, 1911, *Alexander & Kellogg 249* (UC); Tamarack Road, near summit of Mt. Shasta, July 9, 1898, *Baker 354* (UC); near Kentuck's, Tamarack Road, *Baker 439* (UC); near Sisson, 1065 m. alt., June 1–10, 1897, *Brown 334* (M, NY); Shasta, June 17, 1895, *Cannon* (CA); McCloud, July 15, 1911, *Condit* (UC); near Sisson, June 19, 1893, *Dudley* (D); upper Sacramento River, Aug. 26, 1899, *Dudley* (D); meadow, foot of Mt. Eddy, Aug. 4, 1905, *Dudley* (D); McCloud, July 15, 1912, *Eastwood 1109* (CA, Clokey, G, NY); Castle Lake, July 24, 1921, *Eastwood 10791* (CA); n. of Sisson to near Upton, Mt. Shasta, 1050 m. alt., June, 1903, *Hall & Babcock 4067* (UC); in open, swampy places in the forest, Mt. Eddy, 1350 m. alt., July 15, 1915, *Heller 12100* (CA, D, F, G, M, NY, PA); South Fork of Salmon River, near Big Flat, 1500 m. alt., July 23, 1937, *Howell 13366* (CA); Mt. Shasta, 1800 m. alt., June 1, 1914, *Kusche* (CA); mountains about the headwaters of the Sacramento River, 2250 m. alt., Aug. 20, 1881, *Pringle*

82 (F, G); Sisson, Mt. Shasta, July 15, 1902, *Setchell & Dobie* (UC). TRINITY CO.: Pine Creek, Salmon Mts., 1500 m. alt., July, 1909, *Hall 8684* (UC). SHASTA CO.: Burney, June 14, 1923, *Bethel* (CA)*[**]; shore of Summit Lake, Lassen Volcanic National Park, July 15, 1934, *Bonar* (UC); Lassen Peak, 1800 m. alt., July 7, 1897, *Jones* (P); Lassen National Park, near Prospect Peak, Summer, 1932, *Krancer* (CA)*; moist soil in open spaces in woods, 1000-Lake Basin, s. of Burney, 1920 m. alt., July 12, 1932, *Peirson 10130* (UC); Kelly Camp, Mt. Lassen National Park, June 13, 1931, *Van Dyke* (CA). TEHAMA CO.: Dry Lake, n. of Mineral, 1800 m. alt., July 13, 1911, *Eggleston 7205* (G, NY); near Mineral, July 16, 1935, *Epling & Robison* (UCLA); Park's Ranch, Mill Creek Canyon, near Morgan, 1500–2100 m. alt., July 1, 2, 1903, *Hall & Babcock 4321, 4351* (UC); open pine woods, Dry Lake, 7 mi. n. of Mineral on Viola Road, July 16, 1938, *Ownbey & Ownbey 1744* (G, Kew, M, O, UC); Morgan Spring, June 25, 1912, *Wilder* (UC). PLUMAS CO.: moist ground near stream, Warner Valley, below Drakesbad, Mt. Lassen Region, June 20, 1929, *Applegate 5762* (D); yellow pine woods, between Kelley's Camp and Drakesbad, Warner Valley, Mt. Lassen Region, June 21, 1929, *Applegate 5795* (D); without exact locality, May, 1876, *Austin* (F, G TYPE); without exact locality, May, 1877, *Austin* (G, M); Prattville, July 4, 1892, ex herb. *Brandegee* (D)*; Quincy, June 22, 28, 1920, *Clemens* (CA)*; Prattville, July 7, 1902, *Coombs* (G, NY)*; Prattville, Summer, 1906, *Coombs* (CA)*; west end of Hawkins Valley, S. 10, T. 24 N., R. 7 E., 1590 m. alt., June 12, 1934, *Embree 99* (UC); in moist, grassy places, in granite in the yellow pine belt, near the summit of Soapstone Ridge, Sierra Nevada, 12 mi. w. of Bucks, July 7, 1915, *Heller 12066* (CA, D, F, G, M, NY)*; Drakesbad, Mt. Lassen National Forest, June 17–30, 1928, *Hollis* (UCLA); Greenville, July, 1920, *Kelley* (CA); Mohawk Valley, May 27, 1889, *Lemmon* (M, NY, P, UC)*; Silver Lake, 1800 m. alt., July 13, 1929, *Merrill* (CA, UC, UCLA)*; dry meadow and under pines, below Humboldt Summit, on road between Jonesville and Lake Almanor, July 14, 1938, *Ownbey & Ownbey 1740* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS). BUTTE CO.: Colby, July, 1896, *Austin 22* (M, UC)*; Dye Place, June, 1897, *Bruce* (D); Dye Place, 2400 m. alt., May, June, 1898, *Bruce 2405* (NY, P); in low, open woods, Jonesville, 1550 m. alt., July 21, 1929, *Copeland 353* (CA, D, F, G, M, NY, P, RM, UC, UCLA, UO)*; Scotch John Meadows, 1200–1800 m. alt., July 11, 1920, *Copeland 69* (D); in damp woods, Jonesville, 1500 m. alt., June 9, 1931, *Copeland 1513* (D, P); shaded edge of meadow, Jonesville, 1500 m. alt., July 4, 1938, *Copeland* (O); dry hillsides, near Bald Hill, 1800 m. alt., July 8, 1900, *Leiberg 5066* (UO); mountains above Durham, July 4, 1932, *Morrison* (CA). SIERRA CO.: "Sierra Nevada," 1875, *Lemmon 267* (D, F, M)*; Camptonville District, Tahoe National Forest, May, 1931, *Smith* (UC).* NEVADA CO.: Bear Valley, *Hartweg 1986* (G, NY).* PLACER CO.: 1½ mi. w. of Black Mt., S. 4, T. 16 N., R. 12 E., 1740 m. alt., May 28, 1934, *French 370* (UC)*; Emigrant Gap, June 28, 1882, *Jones 3300* (CA, Clokey, D, M, NY, P)*; Cisco, June, 1870, *Kellogg* (D)*; Cisco, July 6, 1923, *Raphael* (CA)*; Cisco, 1780 m. alt., June 26, 1908, *Walker 1317* (UC).* EL DORADO CO.: near Sportsman's Hall, 12 mi. above Placer-

[**] Collections showing characters of both *C. minimus* and *C. nudus* are indicated by an asterisk (*).

ville, May 23, 1907, *Brandegee* (UC)*; under pines, 10 mi. e. of Placerville, May 20, 1917, *Ramaley 11290* (UC).*

Subsection 4. NITIDI.[31]

Flowers campanulate, erect or spreading; petals obovate, cuneate, or in one species triangular-lanceolate and clawed, usually inconspicuously fringed and sparingly bearded above the gland; stems erect, usually with a single, reduced, cauline leaf, rarely branched; fruits 3-winged, erect in all but one species.

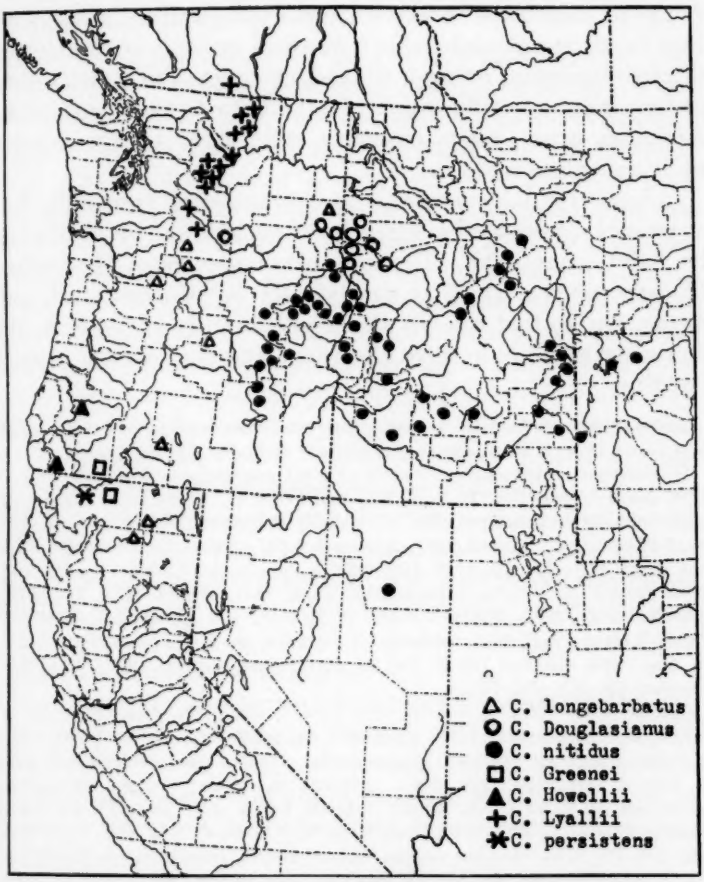
The seven species included under this subsection, although somewhat diverse, appear to represent a very natural alliance. All are so distinct that there is rarely any difficulty in assigning the correct name to a given specimen. *C. longebarbatus* is distinguished from all other members of this group by its short lower internode and bulbiferous habit; *C. nitidus,* by the reddish purple blotch in the middle of each petal; *C. Greenei,* by its lunate, deeply depressed gland; *C. Howellii,* by its branched gland processes; *C. Lyallii,* by its triangular-lanceolate, fringed and clawed petals; *C. persistens,* by its nodding capsule and persistent perianth segments. The only species of this subsection which cannot be distinguished from all other members on the basis of a single morphological character is *C. Douglasianus.* It is remarkable in that it combines certain of the distinctive characters of *C. longebarbatus* and *C. nitidus.* This and other evidence for its probable origin by hybridization between these two species are discussed elsewhere.

15. Calochortus longebarbatus Watson in Proc. Am. Acad. 17: 381. 1882.

Bulb ovoid, with membranaceous coats; stem erect, 1–3 dm. tall, bulbiferous in the axil of the narrow, nearly basal, cauline leaf, subumbellately 1–3-flowered; basal leaf 2–3 dm. long, 5–10 mm. broad, tapering gradually toward both ends, usually shorter than the inflorescence; bracts usually two, opposite,

[31] NITIDI subsect. nov., floribus campanulatis erectis aut patentibus; petalis obovatis cuneatis, in una specie triangulari-lanceolatis et unguiculatis, plerumque inconspicue fimbriatis supra glandulam parce barbatis; caulibus erectis plerumque folio caulino unico reducto, raro ramosis; capsulis 3-alatis, in omnibus speciebus praeter unam erectis.

narrowly lanceolate, long-acuminate, 2–6 cm. long, unequal; flowers lavender-pink, with a deep, purplish red spot on each petal just above the gland, drying purple, erect on rather slen-



Map 4. Distribution of the species of the subsection NITIDI.

der pedicels; sepals shorter than the petals, ovate to lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, obtuse and rounded or acute at the apex, with a few scattered, very

long, flexuous hairs on the inner face above the gland; gland transversely oblong, surface naked, slightly depressed, bordered below with a broad, deeply fringed membrane, and above with a band of short, thick processes, both processes and fringe of membrane beset with numerous papillae; anthers obtuse to short-apiculate, about one-half as long as the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic to nearly orbicular, 3-winged, erect; seeds irregular, with light brown, hexagonally reticulate coats.

Calochortus longebarbatus is distinguished from all other species of the subsection NITIDI by its short lower internode and its bulbiferous habit. The only other species of the section EUCALOCHORTUS which is consistently bulbiferous is *C. uniflorus*, but in that species the whole stem is very short, the flowering pedicels greatly elongated and the capsule usually nodding.

DISTRIBUTION. Infrequent in low, grassy meadows, southeastern Washington, west to the Cascade Mountains, and southward to Shasta County, California.

WASHINGTON. WHITMAN CO.: border of a wet meadow near Oakesdale, July 14, 1916, *Suksdorf 8856* (CA, D, G, M, NY, PA, UC, WS). YAKIMA CO.: Yakima Region, June, 1882, *Brandegee* (M, UC); sandy soil, Smith Spring, S. 1, T. 8 N., R. 15 E., 900 m. alt., July 6, 1932, *Heidenreich 186* (WS). KLICKITAT CO.: Klickitat River, July 17, 1899, *Flett 1123* (WS); wet places, Klickitat Prairie, July, 1880, *Howell 12577* (PA); Goldendale, June, 1881, *Howell* (NY, PA, UO); Klickitat, June, 1881, *Howell 560* (D, F, G, UO); low, grassy grounds, Falcon Valley, July 2, Aug., 1881, *Suksdorf* (F, G TYPE, M, PA); same locality, July 12, Aug., 1882, *Suksdorf* (D, F, NY, PA, UC); same locality, July 2, Aug., 1885, *Suksdorf* (M, NY, UC, UO).

OREGON. HOOD RIVER CO.: moist, open ground, along rills, Hood River Valley, July 3, 1880, *Henderson* (UO); along rills and ponds, Hood River Prairie, June 26, 1882, *Henderson 984* (F); grassy banks of rills, Hood River Valley, June 21, Aug. 2, 1896, *Henderson* (RM). WHEELER CO.: grassy margin, wet meadow, headwaters of Marks Creek, Ochoco National Forest, July 29, 1938, *Ownbey & Ownbey 1800* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); meadow margin, Ochoco Forest, June 30, 1932, *Peck 17200* (WU). KLAMATH CO.: wet meadow near the Cycan [Sycan] River, Aug. 14, 1901, *Cusick 2756* (F, G, M, NY, P, RM, UC, UO).

CALIFORNIA. MODOC CO.: on land wet in Spring, adobe, June–Aug. 1893, *Baker* (UC); Forestdale, Aug., 1897, *Baker 161* (UC); Big Valley, near Lookout, June 29, 1894, *Baker & Nutting* (UC). SHASTA CO.: Goose Valley, June 29, July 11, 1912, *Eastwood 955* (CA, NY, P).

16. Calochortus Douglasianus Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 127. 1829; Schultes & Schultes, Syst. Veg. **7**: 1532. 1830.

Calochortus sp. Douglas in Trans. Hort. Soc. Lond. **7**: 278. 1828.

Calochortus pavonaceus Fernald in Bot. Gaz. **19**: 335. 1894.

Bulb ovoid, with membranaceous coats; stem erect, 2–4 dm. tall, usually with a single, reduced, cauline leaf about midway, simple, subumbellately 1–4-flowered; basal leaf 1–3 dm. long, 10–25 mm. broad, tapering toward both ends, becoming involute, not exceeding the inflorescence; bracts 2 to several, narrowly lanceolate to linear, long-attenuate, 2–10 cm. long, unequal; flowers erect, large and showy, purplish, with a deep purple crescent on each petal above the gland; sepals shorter than the petals, ovate to lanceolate, acuminate, glabrous; petals obovate to oblanceolate, cuneate, rounded or acute at the apex, more or less ciliate laterally and sparingly invested above the gland with long, flexuous hairs; gland more or less triangular-lunate, slightly depressed, bounded below with a narrow, deeply fringed membrane, and covered with short, thick processes, both processes and membrane-fringe densely beset with long papillae; anthers oblong, obtuse, 6–10 mm. long, shorter than the basally dilated filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic to nearly orbicular, 3-winged, erect; seeds irregular, with light-colored, hexagonally reticulate coats.

The original brief description and locality given by Douglas and Schultes are sufficient to identify the name, *C. Douglasianus,* unquestionably, with the present entity. It is also particularly appropriate that one of the most beautiful species of the genus which Douglas, more than anyone else, made known should bear his name.

Calochortus Douglasianus is remarkable in that it combines many of the distinctive characteristics of *C. nitidus* and *C. longebarbatus,* and possesses no single character which will distinguish it from both of these species. In size and habit, it resembles the former, but is separated by its purplish flowers

which have a purple crescent on each petal above the gland. These are both characters of *C. longebarbatus*, from which it differs in its long lower internode and non-bulbiferous habit. In the characters of the gland, it is intermediate between the two, as it is in its choice of ecological habitat. Geographically, it occurs where the ranges of these two species most nearly approach each other. All of this evidence suggests that *C. Douglasianus* may have arisen by hybridization between *C. nitidus* and *C. longebarbatus*, an hypothesis which is in accord with the cytological evidence available. *C. Douglasianus* is a tetraploid species (n = 20), while *C. nitidus* is diploid (n = 10). Little material of *C. longebarbatus* was available for cytological study.

DISTRIBUTION. In low meadows, along creeks, southeastern Washington and adjacent Idaho.

IDAHO. LATAH CO.: Troy, July, 1900, *Abrams 816* (D, P, UC); 7 mi. s. of Moscow, 780 m. alt., July 14, 1937, *Brown 132* (G, Kew, M, O, UC); Thatuna Hills, July 3, 1926, *Epling & Hauch* [*Houck*] *9199* (UCLA); near Moscow, July 1, 1937, *Hanscom* (CA); along creeks and in moist, grassy woods, July 24, Sept. 6, 1894, *Henderson 2484* (RM). CLEARWATER CO.: Clearwater Canyon, near Orofino, July, 1929, *Epling* (UCLA); Orofino, 1898, *Huntting* (WS). NEZ PERCE CO.: Sweetwater, July, 1896, *Heller & Heller* (M, P); about Lake Waha, 750–900 m. alt., July 8, 1896, *Heller & Heller 3397* (D, M, NY, PA, UC); dry plains, Lake Waha, 700 m. alt., July, 1884, *Leiberg* (UO). IDAHO CO.: meadow at base of ridge, Lolo Trail, Bitterroot Mts., Aug. 25, 1880, *Watson 419* (G, PA).

WASHINGTON. WHITMAN CO.: in low, hard-dried places, Pullman, July 2, 1896, *Elmer 222* (M, NY); Pullman, June, 1892, *Henderson 2484* (G, type of *C. pavonaceus* Fernald); bottom land, Pullman, July, 1899, *Hunter* (WS); Union Flat, July 17, 1892, *Lake & Hull 618* (G); in low bottoms, Pullman, July 27, 1892, *Lake & Hull 618* (WS); Pullman, Aug. 10, 1913, *Muenscher* (WS); in low meadows, Pullman, July 24, 1893, *Piper 1680, in part* (G, WS); in bottoms, Pullman, July 18, 1894, *Piper* (RM); in low meadows, Pullman, July 21, 1894, *Piper* (UO). YAKIMA CO.: sand plains, n. of Rattlesnake Mts., May 31, 1901, *Cotton 393, in part* (WS).

17. Calochortus nitidus Douglas in Trans. Hort. Soc. Lond. **7**: 277, *pl. 9A*. 1828.

Cyclobothra nitida Kunth, Enum. Pl. **4**: 230. 1843.

Calochortus eurycarpus Watson, Bot. U. S. Geol. Expl. 40th Par. [Bot. King's Exped.] p. 348. 1871.

Calochortus nitidus var. *eurycarpus* Henderson in Bull. Torr. Bot. Club **27**: 356. 1900.

Calochortus parviflorus Nuttall ex Baker in Journ. Linn. Soc. Lond. Bot. **14**: 306. 1874.

Calochortus umbellatus A. Nelson in Bot. Gaz. **54**: 405. 1912, not Wood, 1868.

Calochortus euumbellatus A. Nelson, *l. c.* Errata.

Bulb ovoid, with membranaceous coats; stem erect, 1–5 dm. tall, with a single, bract-like, cauline leaf about midway, simple, subumbellately 1–5-flowered; basal leaf 1–3 dm. long, 5–25 mm. broad, tapering toward both ends, becoming involute, shorter than the inflorescence; bracts 2 to several, narrowly lanceolate to linear, long-attenuate, 1–5 cm. long, unequal; flowers erect, creamy-white (drying yellowish) to lavender, with a conspicuous red-purple blotch in the middle of each petal; sepals usually much shorter than the petals, ovate to lanceolate, acute to acuminate, glabrous; petals broadly obovate, cuneate, rounded or acute at the apex, invested near the gland with a few, long, flexuous hairs; gland triangular-lunate, slightly depressed, bordered below with a comparatively narrow, deeply fringed membrane, and above often with a narrower, crenate one, enclosed surface densely covered with long, yellowish processes, which, with the membrane-fringe, are often inconspicuously papillose; anthers oblong, obtuse, nearly equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic-oblong, 3-winged, erect; seeds irregular, with light-colored, hexagonally reticulate coats.

Calochortus nitidus is distinguished from *C. Douglasianus*, which it resembles in size and habit, by its usually white petals, which are always marked with a reddish purple spot near the middle. There has been little agreement among American authors as to which of these species should take the name "*C. nitidus.*" The original description and illustration could equally well be applied to either, and presumably Douglas had opportunity to collect both. The present interpretation is based on an examination of photographs of the Douglas specimen preserved in the Hooker Herbarium at Kew. This specimen so closely resembles the original illustration of *C. nitidus*

that it seems to be, with little doubt, the actual historic type. The flower in the drawing is obviously a reconstruction, and that of the original specimen is withered. The petals, however, still show, in the photographs, the characteristic central spot, which definitely associates this name with the above-described species.

DISTRIBUTION. In dry meadows and open coniferous forests, southwestern Montana to southeastern Washington, southward to Elko County, Nevada.

MONTANA. LEWIS AND CLARK CO.: Priests Pass, near Helena, July 31, 1891, *Kelsey* (D, F, NY, P, UC); Priests Pass, Helena, Aug., 1892, *Starz* (M). POWELL CO.: Deer Lodge, July 21, 1901, *Scheuber* (RM). DEER LODGE CO.: Mill Creek, near Anaconda, 1800 m. alt., July 20, 1905, *Jones* (NY, P, UO). SILVER BOW CO.: meadows, 1800–2400 m. alt., July, 1888, *Tweedy 42* (NY). MADISON CO.: among the sagebrush on the slopes, Alaska Basin, Sept. 2, 1899, *Nelson & Nelson 6814* (RM). BEAVERHEAD CO.: open summits and in coniferous woods, Continental Divide at Big Hole Pass, along the Montana-Idaho Line, 8½ mi. e. of Gibbonsville, Idaho, Aug. 17, 1938, *Ownbey & Ownbey 1867* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS).

WYOMING. PARK CO.: dry, open country, foothills, Cody, July 14, 1915, *Marston 161X, in part* (RM). YELLOWSTONE NATIONAL PARK: east shore of Yellowstone Lake, Aug. 22, 1871, *Hayden* (F, G, PA); without exact locality, July, 1926, *Mexia* (CA); without exact locality Aug. 10, 1893, *Rose 165* (CA); without exact locality, 1873, *Parry 265* (G, NY, PA). LINCOLN CO.: near mouth of McKoy Creek, Alpine, July 15, 1923, *Payson & Armstrong 3505* (G, M, P, PA, RM).

IDAHO. FREMONT CO.: Henrys Fork, Snake River, 1872, *Coulter 1048* (PA); parks and woodland, Island Park, Sept. 5, 1899, *Henderson 4804* (G); Snake River, near Henry Lake, Aug. 19, 1892, *Mulford* (M, NY); stony, basaltic field, Route 191, above Warm Creek, Targhee N. F., 1890–1920 m. alt., July 24, 1938, *Pennell & Schaeffer 23485* (PA); ridge north of Ashton, July 29, 1923, *Piper* (WS); forest shade, Trude, July 18, 1932, *Rose 32386* (CA); sandy soil, near Snake River, Rea P. O., Aug. 17, 1916, *Rust 894* (CA); Henry Lake, 2400 m. alt., Aug. 1, 1897, *Rydberg & Bessey 3874* (F, G, NY, PA, RM, UM). MADISON CO.: Menan, Aug. 14, 1895, *Elrod* (F). BONNEVILLE CO.: lower, open slopes, Caribou Mt., July 17, 1923, *Payson & Armstrong 3506* (G, M, P, PA, RM). BUTTE CO.: dry sage-brush plains, along the north side of the big lava flow, w. of Martin and the Craters of the Moon, June 20, 1930, *Applegate 6331* (D, UC); grassy hillside, 1 mi. s. of Martin, 1590 m. alt., June 25, 1938, *Hitchcock, Rethke & Van Raadshooven 3812* (WS). LEMHI CO.: Anderson Mt. Lookout, 2490 m. alt., July 15, 1936, *Blair* (O); Salmon, July, 1896, *Kirtley* (RM); red clay slope, Salmon, 1500 m. alt., July 1, 1920, *Payson & Payson 1850* (CA, G, M, NY, RM). BLAINE CO: among *Artemisia*, Trail Creek, about 5 mi. above Ketchum, July 27, 1938, *Davis 700* (G, Kew, M, O, UC); near Sawtooth, west shore of Alturas Lake, 2130–2190 m. alt., July 22–24, 1896, *Evermann 628* (F); near Sawtooth, head of Alturas Lake, 2160 m. alt., July 30, 31, 1896, *Evermann 664* (F); moist meadow, Lava Lake, 1800 m. alt., July 4, 1916, *Macbride & Payson 3031* (CA, D, G, M, NY, P, RM, UC); open, loamy slopes, Ketchum, 1770 m. alt., July 19, 1911,

Nelson & Macbride 1197 (G, NY, RM, type of *C. umbellatus* Nels., not Wood); open sagebrush land, near Wood River, Ketchum, 1710–1740 m. alt., July 1, 1937, *Pennell 20646* (PA); sagebrush slopes, at end of road along Hyndman Creek, 2010 m. alt., July 27, 1936, *Thompson 13523* (M, NY, PA, WS); alpine slopes at head of Boulder Creek, Sawtooth National Forest, 2700 m. alt., July 13, 1937, *Thompson 14135* (G, NY). CAMAS CO.: dry soil in meadow, Corral, 1710 m. alt., June 28, 1916, *Macbride & Payson 2928* (CA, D, G, M, P, RM, UC). IDAHO CO.: open flat, sandy loam soil, Hibbs Cow Camp, Dry Diggins, Seven Devils Mts., July 27, 1938, *Packard 459* (WS). VALLEY CO.: rocky knoll in yellow pine, south end of Payette Lake, near McCall, 1500 m. alt., July 4, 1937, *Constance 1951* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UM, WS); Payette Lake, 1800 m. alt., July 24, 1899, *Jones* (P); under *Pinus ponderosa* near Warm Lake, 28 mi. n. e. of Cascade, 1500 m. alt., July 23, 1938, *Rollins & Chambers 2591* (O); pine slopes on Gold Fork Lookout, Payette National Forest, Sawtooth Mts., 2100 m. alt., July 13, 1937, *Thompson 13835* (G, NY). BOISE CO.: dry hillside in yellow pine woods, between Garden Valley and Lowman, Payette River, Sawtooth Mts., June 17, 1930, *Applegate 6289* (D, UC). ELMORE CO.: brush-covered, loamy hillside, Toll Gate Ranch, near Dixie, 1350 m. alt., June 28, 1916, *Macbride & Payson 2858* (CA, D, G, M, NY, P, RM, UC). ADAMS CO.: Black Lake to Bear P. O., Seven Devils Mts., 1350–2400 m. alt., July 20, 1931, *Johnston* (CA). WASHINGTON CO.: meadow n. of Cambridge, June 16, 1937, *Davis 178–37* (G, Kew, M, NY, O, RM, UC); Salubria, 690 m. alt., July 10, 1899, *Jones* (CA, M, NY, P); Rush Creek, 1200 m. alt., July 10, 1899, *Jones* (P); Cuddy Mts., 1800 m. alt., July 11, 1899, *Jones* (P); southwest slope of Cuddy Mt., July 3, 1932, *Orr* (UC). ADA CO.: dry hills and plains, Boise (Clear Creek), 1500 m. alt., July 4, 1911, *Clark 75* (D, G, M, RM); Boise City, June, 1881, *Wilcox* (G).

WASHINGTON. ASOTIN CO.: along ridge w. of Big Butte, Blue Mts., June, 1928, *Jones 1891* (WS).

OREGON. WALLOWA CO.: yellow pine woods, Paradise, July 3, 1930, *Applegate 6482* (D, UC); dry sand, head of Hurricane Creek Valley, 2100 m. alt., Aug. 3, 1935, *Constance & Jacobs 1371* (D, WS); gravelly summit of Lookout Mt., among *Artemisia*, west rim of Hells Canyon, Snake River, 2040 m. alt., Aug. 6, 1935, *Constance & Jacobs 1425* (M, UC, WS); dryish, grassy flat at second lake, near source of Wallowa River, 2400 m. alt., Aug. 15, 1908, *Cusick* (UO); open, rocky slope in coniferous woods, along Lick Creek, 24 mi. s. e. of Joseph, Wallowa Mts., Aug. 7, 1938, *Ownbey & Ownbey 1829* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); open slope and in borders of coniferous woods, 13 mi. s. e. of Imnaha, on Hat Point Road, Aug. 8, 1938, *Ownbey & Ownbey 1832* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); open places and borders of coniferous woods 1 mi. n. w. of Hat Point Lookout, above Snake River Canyon, Aug. 8, 1938, *Ownbey & Ownbey 1834* (G, Kew, M, O, RM, UC); moist meadows along Adams Creek, 4 mi. s. w. of Wallowa Lake, Wallowa Mts., Aug. 9, 1938, *Ownbey & Ownbey 1851* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); dry ground, Wallowa Mts., 10 mi. n. of Cornucopia, 2250 m. alt., Sept. 3, 1915, *Peck 3583* (WU); dry ground, Little Sheep Creek Canyon, 12 mi. above Imnaha, July 16, 1933, *Peck 17665* (D, NY, WU); dry slope, Imnaha Canyon, 20 mi. above Imnaha, July 16, 1933, *Peck 17711* (NY, WU); east slope of Lostine Canyon, 20 mi. above Lostine,

July 18, 1933, *Peck 17730* (WU); dry sterile ridge, 28 mi. n. of Enterprise, June 23, 1934, *Peck 18219* (D, WU); near summit of Imnaha-Snake Divide, 23 mi. above Imnaha, July 12, 1933, *Peck 176621* (D, NY, WU); Powder River Mts., Aug., 1896, *Piper 2460* (NY, UO, WS); Elk Mt., 1500 m. alt., June 30, 1897, *Sheldon 8462* (M, NY). UNION CO.: about Crater Lake, near Wallowa, Wallowa Mts., 2400 m. alt., Aug. 8, 1938, *King 512* (UO); dry ground, Beaver Meadows, 10 mi. w. of North Powder, Aug. 17, 1915, *Peck 3582* (WU); mountain above La Grande, July 29, 1910, *Peck 3584* (WU); Union, *Purdy* (UC). BAKER CO.: Hereford, July 3, 1930, *Jones 25180* (D, M, P). UMATILLA CO.: Ukiah, June 23, 1935, *Sipe* (UO). GRANT CO.: open hill above Strawberry Creek, 5 mi. s. of Prairie City, July 1, 1919, *Ferris & Duthie 744* (D); moist, rocky slopes of Dixie Mt., Blue Mts., 2250 m. alt., July 26, 1925, *Henderson 5627* (CA, D, G, M, UO); moist or dry borders of natural meadows, Austin Ranch, July 21, 1925, *Henderson 5628* (CA, D, G, M, UO); dry slope, Blue Mt. Springs, 14 mi. s. e. of Prairie City, July 19, 1921, *Peck 10325* (D, F, NY); yellow pine slopes, 10 mi. n. of Seneca, 1200 m. alt., July 6, 1935, *Thompson 11927* (D, NY, WU). HARNEY CO.: Camp Harney, 1875, *Bartholt* (M); yellow pine slopes, 25 mi. n. of Burns, July 16, 1936, *Thompson 13304* (NY, PA, WS, WU).

NEVADA. ELKO CO.: canyon at the head of South Fork of the Humboldt, East Humboldt or Ruby Mts., 2160 m. alt., Aug. 11, 1908, *Heller 9385* (D, G); East Humboldt Mts., 2250 m. alt., Aug., 1868, *Watson 1173, in part* (G, type of *C. eurycarpus* Watson).

STATE NOT DETERMINED: "On the mountains of the interior," *Douglas*, photograph, of TYPE in the Hooker Herbarium at Kew (G, NY, P, PA, WS); "Rocky Mts.," *Nuttall* (G), type collection of *C. parviflorus* Nuttall.

18. Calochortus Greenei Watson in Proc. Am. Acad. **14**: 264. 1879.

Calochortus Greenei var. *calvus* Henderson in Rhodora **33**: 204. 1931.

Bulb ovoid, with membranaceous coats; stem erect, 1–3 dm. tall, with one or two reduced, cauline leaves, simple or with a branch in the axil of one of the cauline leaves, subumbellately 1–5-flowered; basal leaf about 2 dm. long, 1–2 cm. broad, tapering upward, strongly involute, not exceeding the inflorescence; bracts 2 to 4, narrowly lanceolate to linear, long-acuminate, 2–4 cm. long, unequal; flowers erect on long pedicels, purplish, with a darker purple crescent on each petal above the gland; sepals shorter than the petals, ovate, acuminate, glabrous; petals broadly obovate, cuneate, rounded at the apex, loosely bearded above the gland with long flexuous hairs; gland lunate, deeply depressed, surface naked, bordered below with a broad, deeply fringed membrane, and above with a series of short,

thick processes, both processes and membrane-fringe densely beset with long papillae; anthers oblong-lanceolate, obtuse or acute, 8–12 mm. long, nearly equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute, 3-winged, erect; seeds not known.

Calochortus Greenei resembles *C. nitidus* and *C. Douglasianus* in size and habit, but is easily distinguished from both by its deeply depressed, lunate gland. This species has been a puzzle to western botanists who, lacking authentic material, have almost without exception associated Watson's name and description with Californian specimens of the very different *C. longebarbatus*. Watson, himself, was apparently unaware of the characters which distinguish this from related species. His original description, however, was drawn from Greene's Table Rock collection, which must therefore be considered as the type. Specimens of the type collection of *C. Greenei* var. *calvus* seem to be identical in every respect.

DISTRIBUTION. Brushy hillsides, Jackson County, Oregon, near the California Line, and on top of Table Rock, Siskiyou County, California.

OREGON. JACKSON CO.: in copses and on open slopes, south slope of Siskiyou Mts., near the California Line, July 12, 1930, *Henderson 12809* (UO), type collection of *C. Greenei* var. *calvus* Henderson; open brushy hillside, 4 mi. n. of the California Line, June 24, 1931, *Peck 16381* (WU).

CALIFORNIA. SISKIYOU CO.: on top of Table Rock, Little Shasta River, July 6, 1876, *Greene 914* (G TYPE, M, PA).

19. Calochortus Howellii Watson in Proc. Am. Acad. **23**: 266. 1888.

Bulb ovoid, with membranaceous coats; stem slender, erect, 2–3 dm. tall, with a single bract-like, cauline leaf at or above the middle, simple or rarely with a branch in the axil of the cauline leaf, subumbellately 1–3-flowered; basal leaf 2–3 dm. long, about 5 mm. wide, tapering gradually upward; bracts two, subopposite, linear to narrowly lanceolate, attenuate, 1–3 cm. long; flowers yellowish-white, with purplish hairs toward the base of the petals, erect on rather slender pedicels; sepals shorter than the petals, ovate, acuminate, glabrous; petals broadly obovate, cuneate, rounded at the apex, inconspicuously

fringed laterally and sparingly clothed on the inner face with short hairs; gland transversely oblong, slightly depressed, densely covered with short, distally branched processes, the bases of those at the lower margin united to form an inconspicuous, discontinuous membrane; anthers oblong-lanceolate, acute to short-apiculate, exceeding the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute at both ends, 3-winged, erect; seeds irregular, light-colored, without reticulate coats.

Calochortus Howellii has no very close relatives. Its habit and erect capsule place it with the subsection NITIDI, but its distally branched gland-processes and merely roughened seed-coats mark it as very distinct from any other known species of the section EUCALOCHORTUS.

DISTRIBUTION. Oregon: dry, rocky soil, near Roseburg, Douglas County, and near Waldo, Josephine County.

OREGON. DOUGLAS CO.: Roseburg, June 7, 1887, *Howell 727* (G TYPE). JOSEPHINE CO.: Waldo, June 22, 1910, *Howell* (UO); Waldo, June 18, 1884, *Howell 294* (G); dry hillsides, near Waldo, July 7, 1887, *Howell 1282* (M, NY, PA); Waldo, July, 1889, *Howell* (F); rocky soil along Whiskey Creek, 6 mi. s. w. of Waldo, July 23, 1938, *Ownbey & Ownbey 1770* (CA, D, F, G, Kew, M, NY, O, RM, UC); near Waldo, Aug. 4, 1913, *Peck 1376* (WU); dry, stony ground, 6 mi. s. w. of Waldo, July 4, 1918, *Peck 7848* (F); dry ground along West Fork of Illinois River, 8 mi. w. of Waldo, July 4, 1918, *Peck 8413* (G).

20. Calochortus Lyallii Baker in Journ. Linn. Soc. Lond. Bot. **14**: 305. 1874.

Calochortus ciliatus Robinson & Seaton in Bot. Gaz. **18**: 238. 1893.

Bulb ovoid, with membranaceous coats; stem erect, 1–5 dm. tall, usually with a single bract-like leaf about midway, simple or with a branch in the axil of the cauline leaf, subumbellately 1–4(–9)-flowered; basal leaf 1–3 dm. long, 2–20 mm. broad, tapering toward both ends, usually not exceeding the inflorescence; bracts 2 to several, lanceolate to linear, attenuate, 1–5 cm. long, unequal; flowers white or purplish-tinged, usually with a purple crescent on each petal above the gland, and a similar spot on each sepal, erect or spreading on rather slender pedicels which become stouter and stiffly erect in fruit; sepals

usually about equalling the petals, lanceolate, acuminate to attenuate, often papillose on the inner face, glabrous; petals ovate to lanceolate, acute, abruptly contracted at the base to a short claw, usually conspicuously fringed with long, slender hairs, inner face more or less papillose, invested with a few long hairs above the claw; gland transverse, arched upward, depressed, bordered below with a broad, ascending, deeply fringed membrane, and above with a narrower membrane which is merely crenate, invested toward the upper portion of the enclosed surface with short, thick processes, both fringe of lower membrane and the processes densely long-papillose; anthers oblong-lanceolate, acute to short-apiculate, usually equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute at both ends, 3-winged, nodding; seeds irregular, with light-colored, more or less hexagonally reticulate coats.

Calochortus Lyallii has no close relatives. Its small flowers and conspicuously ciliate and clawed petals distinguish it at once from any other species of the subsection NITIDI, and suggest affinity with the subsection ELEGANTI. These resemblances, however, are entirely superficial, and its erect capsules definitely exclude it from that subsection.

DISTRIBUTION. Dry slopes, southern British Columbia, southward along the eastern front of the Cascade Mountains to Yakima County, Washington.

BRITISH COLUMBIA. Open hilltops near Similkameen River, 1050 m. alt., June 14, 1905, *Macoun 70212* (F, G, M, P).

WASHINGTON. OKANOGAN CO.: dry soil on bunch-grass flat, near Twisp, 480 m. alt., May 15, 1936, *Edwards 220* (WS); vicinity of Omak, May 14, 1931, *Fiker 88* (WS); Oroville, June 24, 1911, *Jones* (P); Conconully, July 3, 1911, *Jones* (D, P, UC); dry, open woods, limestone hills, Riverside, July 1, 1923, *St. John 7718* (G, M, WS); near Conconully, *Steward 203* (UM); open, timbered slopes near Salmon Meadows, 1050 m. alt., June 28, 1931, *Thompson 7057* (D, G, M, PA, UC); pine woods by Loop-Loop Road, e. of Winthrop, 1050 m. alt., July 2, 1934, *Thompson 10916* (D, M, NY). CHELAN CO.: Lake Wenatchee, July 24, 1910, *Bailey* (UCLA); Wenatchee Region, July, 1883, *Brandegee 1107* (G); hills, Mission Creek, Cashmere, May 15, 1923, *Jones* (WS); Cashmere, May 28, 1913, *Mann 1* (RM); mountainside w. of Leavenworth, 360 m. alt., May 15, 1918, *Otis 673* (CA); Leavenworth, July, 1919, *Phelps* (CA); open woods, granite slide, Chelan, May 20, 1928, *St. John, Eggleston, Beals & Warren 9414* (NY, WS); dry, sandy hillside, Leavenworth, May 18, 1928, *St. John, Eggleston, Beals & Warren 9500* (WS); Peshastin, July, 1893, *Sandberg & Leiberg* (WS); slopes of Mt. Stuart, 1219–1524 m. alt., July 24, 1893, *Sandberg & Leiberg 575* (CA, F, G, M, NY,

PA, UC, UO, WS); among dry sagebrush at Leavenworth, May 23, 1931, *Thompson 6424* (D, G, M, PA); open, rocky slopes, Lookout Mt., near Leavenworth, 600 m. alt., May 23, 1931, *Thompson 6449* (D, G, M, PA); lower wooded slopes of Dirtyface Peak, 900 m. alt., June 24, 1932, *Thompson 8558* (D, G, M, NY, UC); yellow pine slopes of Tumwater Mt., 600 m. alt., May 12, 1934, *Thompson 10435* (D, M, NY, P); yellow pine slopes along Entiat River, near Entiat, May 18, 1935, *Thompson 11476* (D, G, NY, P, WS); Wenatchee, May 28, 1896, *Whited 40* (WS); sandy soil, rocky slope near Icicle Creek, w. of Peshastin, S. 25, T. 24 N., R. 11 E., 600 m. alt., June 16, 1936, *Wilcoxon 2* (WS). KITTITAS CO.: Wenatchee Mts., June 29, 1903, *Cotton 1266, 1313* (WS). YAKIMA CO.: Yakima Region, June, 1882, *Brandegee* (G, M, UC); Ahtanum Creek, S. 32, T. 12 N., R. 15 E., 330 m. alt., May 31, 1932, *Heidenreich 128* (WS); grassy, pine woods, Upper Naches River, June 15, July 16, 1892, *Henderson 2485* (G, type of *C. ciliatus* Robinson & Seaton, RM).

21. Calochortus persistens Ownbey, n. sp.[32]

Bulb ovoid, with membranaceous coats; stem low, erect, about 1 dm. tall, stout, more or less flexuous, with a single, bract-like, cauline leaf above the middle, simple or with a branch in the axil of the cauline leaf, subumbellately 2-flowered; basal leaf about 2 dm. long, 15–20 mm. broad, tapering toward both ends, exceeding the inflorescence; bracts 2, opposite, lanceolate, acuminate, unequal, 2–3 cm. long; flowers large, purplish, erect on rather stout pedicels which become deflexed in fruit; sepals shorter than the petals, elliptic-lanceolate, acuminate, glabrous; petals obovate, cuneate, obtuse or acute, fringed laterally, and invested above the gland with a patch of long, yellow hairs; gland transverse, more or less lunate, surface naked, depressed, bordered below with a broad,

[32] **Calochortus persistens** sp. nov., bulbo ovoideo membranaceo-tunicato; caule humili erecto circiter 1 dm. alto robusto plus minusve flexuoso, supra medium folio caulino solitario bractiali, simplici aut ramoso in axillo folii caulini, subumbellate 2-floro; folio basali circiter 2 dm. longo, 15–20 mm. lato, ad utrumque extremum attenuato, inflorescentiam superante; bracteis 2, oppositis lanceolatis acuminatis inaequalibus, 2–3 cm. longis; floribus magnis purpurellis erectis in pedicellis subrobustis et fructu deflectentibus; sepalis petalis brevioribus elliptico-lanceolatis acuminatis glabris; petalis obovatis cuneatis obtusis aut acutis lateraliter fimbriatis, supra glandulam fasciculo pilorum longorum fulvorum praeditis; glandula transversa sublunata, superficie nuda, depressa, subter membrana lata adscendente late fimbriata marginata, supra serie processorum brevium, et processis et fimbria membranae papillis longis dense praeditis; antheris lanceolatis apiculatis filamentis basilariter dilatatis subaequilongis; ovario 3-alato, stylo brevi, stigmate persistente trifido; capsula elliptica acuta 3-alata cernua, segmentis perianthii diuturne persistentibus parte inclusa; seminibus ignotis.

ascending, deeply fringed membrane, and above with a series of short processes, both processes and fringe of the membrane densely beset with long papillae; anthers lanceolate, apiculate, about equalling the basally dilated filaments in length; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic, acute, 3-winged, nodding, partially enclosed by the long-persistent perianth segments; seeds unknown.

The long-persistent perianth segments mark this species at once as distinct from any other species of the section EUCALOCHORTUS. Its nodding capsule separates it from the remainder of the subsection NITIDI, and suggests affinity with the subsection ELEGANTI, but on all other characters it is best placed with the former subsection. It is apparently very localized, and has been missed entirely by botanical collectors since Greene discovered it in 1876, although Mr. Carl Purdy has handled bulbs of it, as *"C. Greenei,"* for years. Greene's collection at the Gray Herbarium was included under *C. Greenei* by Watson, but his description of that species was drawn entirely from Greene's Table Rock specimens, which represent another very distinct and localized entity. Greene recognized the distinctness of his two collections and protested against their inclusion under a single species, but his letters were placed with the sheet in the Gray Herbarium and presumably forgotten. Writing from Silver City, New Mexico, March 7, 1881, Greene says:

> The *Calochortus* herewith enclosed, you called, in 1876 *"C. apiculatus,* Baker," but afterwards you appear to have made it a part of your *C. Greenei.* Am I correct in so believing? If so, I beg you to let the tall, umbellately branched one, from Table Rock on Little Shasta, be so called, & this *C. Watsoni;* for this is distinct from that, notwithstanding the close likeness in the petals. It even belongs to § 1 of the genus. The fruiting pedicels, & even the flowering at a certain stage of advancement, are strongly recurved. But it does not seem referable to any of the published species of that section. What do you say?

Writing again on April 16, of the same year, he adds:

> I have had no time to take a second look at those *Calochorti* since you wrote that the small one is not of the *Eucalychorti.* I thought its recurved *(strongly so)* fruiting pedicels were enough to place it there; but do not remember about other points. No one who has ever seen the two growing will be convinced that

they are one species, and the distinctions should be made out,—the matter cleared up—as soon as possible, by ourselves. One important note which I think I neglected to make to you is, the marked difference in shape of flowers. Those of the tall one (from which the char. of *C. Greenei* seems to have been mainly drawn) are what I call cup-shaped, i. e. the orifice not at all spreading, or expanded, & the base nearly as broad; those of the short one are, in shape like those of *C. Nuttallii, C. Gunnisonii* &c. You recognize, I know, the importance of this kind of character, in the genus, but know how easily it disappears in the process of pressing & drying. I wish, if you have sufficient faith in the accuracy of my observations, you would accept the aid of my several notes &, when it falls to your hand, straighten the matter out. I fully sympathize with your objection to having it called *C. Watsoni*, though such things have been done I see, already, with your name, as with that of many another author.

DISTRIBUTION. California: known only from the type locality.

CALIFORNIA. SISKIYOU CO.: mountains near Yreka, June 30, 1876, *Greene 903* (F, G TYPE, M, PA); grown from bulbs secured from Carl Purdy as "*C. Greenei*," *Ownbey & Ownbey* (O).

SECTION II. MARIPOSA

MARIPOSA Wood in Proc. Acad. Philad. [**20**]: 168. 1868; Watson in Proc. Am. Acad. **14**: 264. 1879; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 127. 1901, as section; Baker in Journ. Linn. Soc. Lond. Bot. **14**: 308. 1874, as subgenus.

Platycarpus Baker, *l. c.* 305, as subgenus, in part.

Bulbs ovoid, with membranaceous coats; stems rarely branched, often bulbiferous in the axils of the lower cauline leaves; leaves linear, attenuate, the basal one usually withering before anthesis; inflorescences monochasial or subumbellate, the flowers campanulate, erect; sepals lanceolate, obtuse to attenuate, usually glabrous; petals obovate to oblanceolate, cuneate, rounded and obtuse to acuminate, usually sparingly bearded near the gland; glands variously shaped, sometimes depressed, with or without a membrane, densely covered with more or less filiform or distally branched processes; anthers oblong to linear, obtuse to apiculate; ovaries linear, rarely winged, tapering to a persistent, trifid stigma; fruits oblong to linear, 3-angled or narrowly 3-winged, erect; seeds more or less flattened, with hexagonally reticulate coats. (Spp. 22–42).

TYPE SPECIES: **Calochortus venustus** Douglas.

The species of the section MARIPOSA are distinguished by

their membranaceous bulb coats and usually 3-angled capsules. In the latter character, they are connected with the section EUCALOCHORTUS by *C. catalinae,* which has narrowly 3-winged fruits. There is no question, however, but that this species properly belongs in MARIPOSA, as it is, in all other respects, similar to the other species of this section, and very different

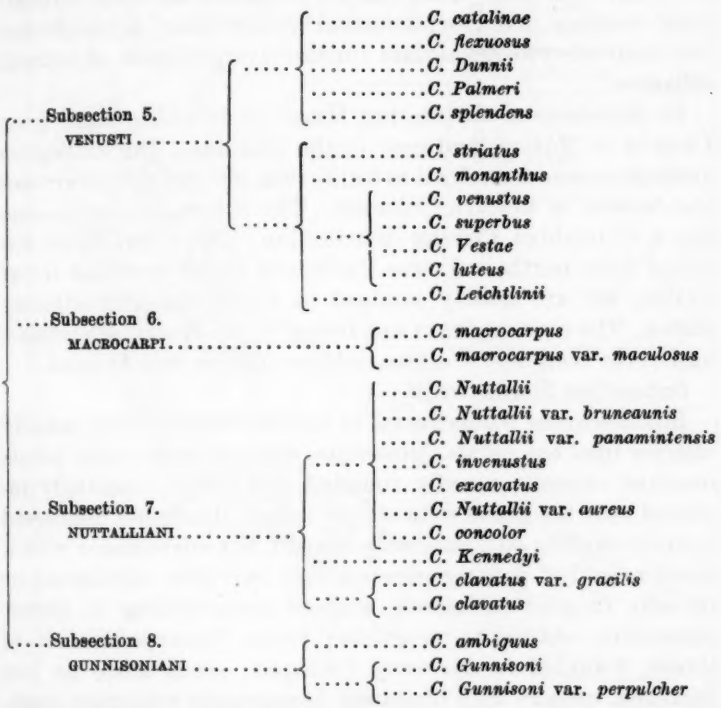


Fig. 2. Diagram showing the morphological relationships of the subsections, species and varieties of the section MARIPOSA.

from any species included in the section EUCALOCHORTUS. Unlike most of the species of the other two sections, the basal leaves of MARIPOSA usually wither before anthesis and are but rarely collected.

Morphologically, MARIPOSA is the most uniform of the three sections of *Calochortus.* The four subsections, although ap-

parently very natural, are distinguished on relatively inconspicuous characters, and the species are often very difficult to delimit. In contrast to this morphological uniformity, MARIPOSA is the most varied of the sections cytologically. In the subsection VENUSTI, the basic chromosome number is six or seven; in the MACROCARPI, seven; in the NUTTALLIANI, eight; and in the GUNNISONIANI, nine. This exact correlation between chromosome number and morphological subdivisions demonstrates the value of cytological data for the interpretation of natural alliances.

In distribution, the section MARIPOSA is widespread, from Canada to Mexico, and east to the Dakotas. The subsection VENUSTI is almost confined to California, but one species crosses the deserts to western Colorado. The subsection MACROCARPI has a Columbian Plateau distribution. The NUTTALLIANI are found from northern Lower California to the northern Great Plains, but are mostly confined to California and adjacent states. The GUNNISONIANI are found in the Rocky Mountains, and in the semi-desert regions of New Mexico and Arizona.

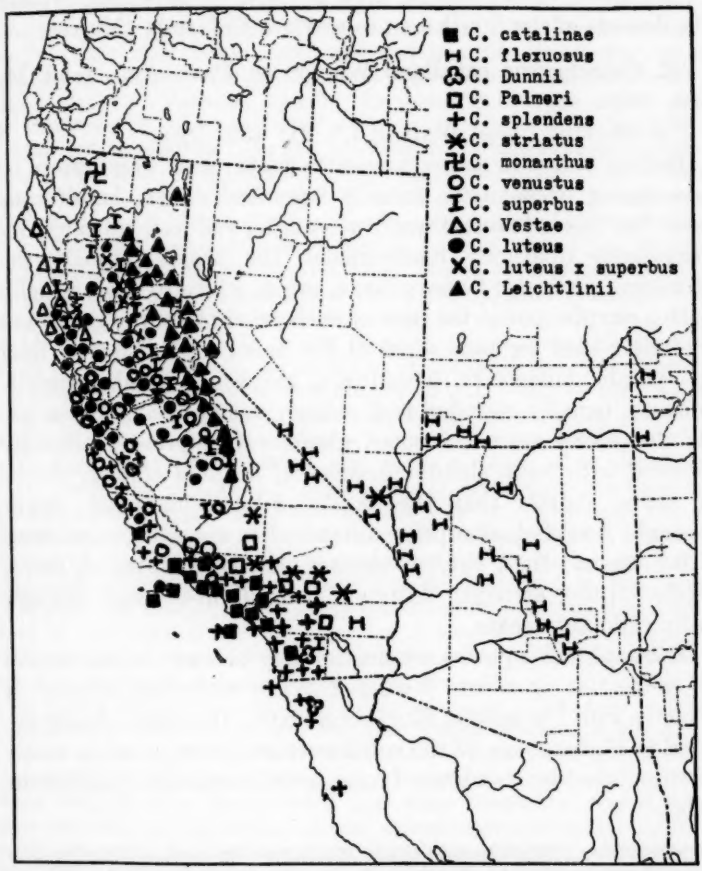
Subsection 5. VENUSTI.[33]

Inflorescences monochasial or subumbellate; sepals usually shorter than the petals, lanceolate, acute to acuminate; petals obovate, cuneate, usually rounded and obtuse, sparingly invested near the gland with simple hairs; glands not depressed (rarely slightly so), variously shaped, not surrounded with a membrane, but densely covered with hair-like, subclavate or distally fungoid processes; anthers linear-oblong to linear-lanceolate, obtuse to apiculate; fruits linear-lanceolate to linear, 3-angled to narrowly 3-winged; seeds more or less flattened, usually with obscurely hexagonally reticulate coats.

The VENUSTI are distinguished by their plane gland-surface

[33] VENUSTI subsect. nov., inflorescentiis monochasialibus aut subumbellatis; sepalis petalis plerumque brevioribus lanceolatis acutis vel acuminatis; petalis obovatis cuneatis plerumque rotundo-obtusis, prope glandulam pilis simplicibus parce praeditis; glandulis non depressis (raro subdepressis) diversiformibus, membrana non circumdatis sed processis filiformibus subclavatis aut apice fungiformibus dense vestitis; antheris lineari-oblongis vel lineari-lanceolatis obtusis vel apiculatis; capsulis lineari-lanceolatis vel linearibus triangulatis vel anguste 3-alatis; seminibus plus minusve complanatis, testis plerumque obscure hexagono-reticulatis.

and lack of a gland-membrane. Although the species fall into distinct alliances, those with definitely monochasial inflorescences, and those in which the inflorescence is subumbellate,



Map 5. Distribution of the species and hybrids of the subsection VENUSTI.

the subsection seems to be a very natural one. The species of the first alliance are well defined, while those of the second are somewhat difficult of delimitation. The chromosome base number of the entire subsection, as far as known, is six or seven.

The latter number is the usual one. Two cases of triploidy and one of tetraploidy are known. In distribution, the subsection is almost limited to California. Two species, *C. Leichtlinii* and *C. striatus,* reach Nevada, while a third, *C. flexuosus,* crosses the deserts of the Southwest to western Colorado (Map 5).

22. Calochortus catalinae Watson in Proc. Am. Acad. **14**: 268. 1879.

Calochortus Lyoni Watson, *l. c.* **21**: 455. 1886.

Bulb ovoid, with membranaceous coats; stem erect, more or less zigzag or flexuous, usually branched above, bulbiferous near the base; leaves linear, attenuate, reduced upward; inflorescence distinctly monochasial, the bracts opposite the flowering pedicels; flowers large, erect, white to lilac, usually with a purple spot at the base of each petal about the gland and a similar spot on each sepal at the base; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals obovate, cuneate, usually rounded and obtuse, naked except for a few slender hairs near the base; gland not depressed, densely covered with long, slender processes; anthers oblong, obtuse or acute, shorter than the basally dilated filaments; ovary strongly 3-angled, abruptly contracted to a sessile, persistent, trifid stigma; fruit oblong, obtuse, narrowly 3-winged, erect; seeds elliptic, strongly flattened, with light-colored, hexagonally reticulate coats.

Although this species unquestionably belongs in the section MARIPOSA, its narrowly 3-winged ovary and fruit connect it directly with the section EUCALOCHORTUS. It is most closely related to *C. flexuosus* of the southwestern deserts, but is easily distinguished by its obtuse fruits, erect stems and bulbiferous habit.

DISTRIBUTION. California: open slopes, usually near the coast, southern San Luis Obispo County, southward to San Diego County; also on the Santa Barbara Islands.

CALIFORNIA. SAN LUIS OBISPO CO.: Pismo Beach, April 5, 1934, *Jones* (P). SANTA BARBARA CO.: Santa Barbara, 1886, *Bingham* (UC); roadside, Santa Barbara, March 4, 1884, *Dexter* (G); Mission Creek, May 11, 1908, *Eastwood* (CA); Carpinteria, April 6, 1929, *Jones 26107* (D, M, P, UM); dry slope, Mountain Drive, April 12, 1926, *Munz 10337* (P, UC); Santa Barbara, April 19, 1887, *Smith* (PA). SANTA CRUZ ISLAND: Valle del Medio, April 10, 1931, *Howell 6186*

(CA); without exact locality, June 6, 1918, *Miller* (CA); among cactus, Portazuela, April 12, 1931, *Sheldon* (Clokey). SANTA ROSA ISLAND: without exact locality, April 8, 1930, *Hoffmann* (CA); grassy slopes, below Torrey Pines, April 8, 1930, *Munz & Crow 11615* (P). VENTURA CO.: Santa Paula, April 3, 1908, *Cobb 134* (UC); Nordhoff, April 21, 1916, *Eastwood 4956* (CA); Griffins, Mt. Pinos, July, 1902, *Elmer 3962* (D, F, G, M, NY); Sulphur Mt., April 3, 1931, *Epling & Anderson* (NY, PA, UCLA); Ventura, April, 1921, *Evermann* (CA); Casitas Pass, 180 m. alt., May 6, 1902, *Hall 3137* (D, UC); rocky slope, Conejo Grade, May 9, 1930, *Howell 4773* (CA); Camarilla, April 27, 1926, *Jones* (P); Cuyama Canyon, April 28, 1926, *Jones* (P); Ventura, 1923, *Kendall* (P); burn in chaparral, Ojai Valley, April 6, 1930, *Munz & Crow 11495* (P). LOS ANGELES CO.: Sepulveda Canyon, Santa Monica Mts., April, 1899, *Abrams 251* (D); Santa Monica Mts., April 3, 1901, *Abrams 1266* (D, M, P); grassy slopes, San Pedro Hills, March 14, 1903, *Abrams 3143* (D, G, M, NY, P, PA, UCLA); Glendora, May 5, 1902, *Braunton 268* (D, UC); Mandeville Canyon, near Santa Monica, April 20, 1928, *Bryan 53* (P); Hollywood, April 24, 1918, *Carlson* (CA); open hillside, Puddingstone Dam, May 9, 1935, *Clokey & Anderson 6545* (Clokey, F, M, NY, P); openings among brush, dry ridge, Mandeville Canyon, Santa Monica Mts., 425 m. alt., April, 1929, *Clokey & Templeton 4426* (Clokey, F, G, NY, P, UC); hillsides, Santa Monica Mts., March 28, 1916, *Crawford & Hiatt 568* (D, P); Los Angeles, May, 1894, *Davidson* (G); Garvanza, May 27–June 10, 1906, *Eastwood 19* (CA); Topanga Canyon, May 8, 18, 1926, *Epling* (UCLA); Los Alisos Canyon, May 9, 1931, *Epling* (CA, D, F, M, NY, PA, UC, UCLA); Topanga Canyon, May 18, 1929, *Epling & Ellison* (UCLA, UM); Las Flores Canyon, March 28, 1930, *Epling & Ellison* (F, M, UC, UCLA, UM); grassy slope, ridge above Providencio Rancho, Santa Monica Mts., May 25, 1929, *Ewan 3485* (P); Newhall, Feb.–May, 1885, *Gray* (G); Sierra Santa Monica, May 11, 1902, *Hall 3263* (D, UC); hillsides, Pacific Palisades, July 16, 1931, *Hastings* (NY); Topanga Canyon, May 19, 1933, *Hilend* (UCLA), Los Angeles, May 1, 1882, *Jones 3212*, (CA, Clokey, M, NY, P); Malibu Hills, April 26, 1926, *Jones* (P); San Dimas, April 20, 1927, *Jones* (P); Temescal Canyon, Santa Monica Mts., April 8, 1923, *Lloyd* (UC); hills about Los Angeles, 1885, *Lyon* (G, type of *C. Lyoni* Watson); ridge s. w. of Museum Hill, Los Angeles, April 14, 1916, *Moxley 306* (CA); dry hillside, Topanga Canyon, Santa Monica Mts., 210 m. alt., May 17, 1920, *Munz & Harwood 3991* (P, RM); grassy hillside, Lone Hill, April 19, 1919, *Munz, Street & Williams 2486* (D, P); rocky hillside, at mouth of Los Alisos Canyon, Santa Monica Mts., June 27, 1938, *Ownbey & Ownbey 1667* (CA, D, F, G, Kew, M, NY, O, RM, UC); hillsides, Lone Hill, near San Dimas, April 19, 1919, *Parish 19296* (G, UC); hillside, Malibu Road, Santa Monica Mts., May 11, 1935, *Purer 6558* (M). SANTA CATALINA ISLAND: without exact locality, May 11, 1890, ex herb. *Brandegee* (G); Avalon, April 28, 1914, *Carlson* (CA, F); Avalon, May 7, 1918, *Carlson* (M); grassy hills, Isthmus, 90 m. alt., March 17, 1928, *Dunkle 1752* (P); dry, grassy hillsides, Little Harbor, 60 m. alt., March 31, 1928, *Dunkle 1762* (P); open north slope, hill n. of Avalon, 50 m. alt., May 6, 1932, *Fosberg 8167* (M, P, UCLA); Avalon, March 30, 1900, *Grant* (D); open plain, March, 1901, *Grant 2378* (NY); without exact locality, April 21–26, 1904, *Grant & Wheeler 126a–1847* (D, F, M, PA, RM, UC); Avalon Canyon, April 26, 1932, *Herley* (UCLA); Isthmus, May 29, 1927, *Jones* (P); stony soil of hillside, head of Hamilton Canyon, April 17, 1921, *Knopf 87* (F); gravelly soil, hillside above Wireless Station, Pebble Beach

Road, May 15, 1921, *Knopf 107* (Clokey, F); Cottonwood Canyon, April 30, 1922, *Knopf 399* (F); hillside above gas plant, May 22, 1922, *Knopf 417, 438, 439* (F); without exact locality, June 11, 1918, *Miller* (CA); Schoolhouse Ridge, April 28, 1920, *Nuttall 6* (F); without exact locality, 1878, *Schumacher* (F, fragment, G TYPE, NY); Avalon Canyon, 24 m. alt., May 26, 1912, *Smith 4985* (F). SAN BERNARDINO CO.: dry clay mesa top, among grass, Red Hill, near Upland, April 28, 1917, *Johnston 1210* (Clokey, D, P, UM); Serrano Club Grounds, Chino, May 1, 1926, *Jones* (CA, D, NY, P); grassy slope, Red Hill, near Upland, April 25, 1918, *Munz 2098* (P); dry hills, Upland, May 2, 1917, *Parish 11149* (UC). ORANGE CO.: Santiago Creek, May, 1899, *Bowman* (D); Fullerton Hills, April 14, *Hilend 15* (UCLA); hillsides, Santa Ana River Canyon, May 3, 1919, *Munz, Street & Williams 2624* (P); Santa Ana Canyon, April 11, 1922, *Pierce* (P). SAN DIEGO CO.: Ramona, April 20, 1891, *Thurber* (F).

23. Calochortus flexuosus Watson in Am. Nat. 7: 303. 1873.

Bulb ovoid, with membranaceous coats; stem erect or often more or less decumbent and twining, usually branched, rarely bulbiferous; leaves linear, attenuate, reduced upward; inflorescence monochasially 1–4-flowered, its internodes short; flowers campanulate, erect, white to pink, each petal with a transverse yellow band at the gland, and usually a purple spot on the claw, sepals similarly marked; sepals shorter than the petals, lanceolate, obtuse or acute, glabrous; petals obovate, cuneate, rounded and obtuse above, sparsely invested near the gland with short, thick hairs; gland not depressed, transversely lunate to nearly circular, densely covered with rather short processes; anthers oblong, obtuse or umbonate, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit lanceolate, acute, 3-angled, erect; seeds strongly flattened, with light-colored, hexagonally reticulate coats.

Well-developed specimens of this species are distinguished by their characteristic, flexuose-twining habit. In depauperate specimens, however, this character is not so evident, and, due to the uncertainty of favorable growing conditions throughout the range, such specimens are not infrequent. The lanceolate, acute capsules are also characteristic, and fruiting specimens could not be very easily confused with those of any other species. Its nearest ally seems to be *C. catalinae*, but the relationship is remote, and the two are easily separated on a number of characters.

DISTRIBUTION. On desert hills and mesas, southwestern Colorado, westward to southern Nevada and adjacent California, southward to central Arizona.

COLORADO. MONTROSE CO.: red clay soil, Naturita, 1620 m. alt., May 12, 1914, *Payson 289* (F, G, M, RM, WS); same locality, May 26, 1914, *Payson 357* (F, G, M, RM, WS). MONTEZUMA CO.: McElmo Creek, June, 1892, *Eastwood* (F).

UTAH. KANE CO.: Kanab, *Thompson* (G TYPE). WASHINGTON CO.: dry hillside, 10 mi. e. of St. George, May 10, 1938, *Barkley 3207* (O); sandstone mesa n. of St. George, May 17, 1933, *Benson 31* (UC); lava hill, Belveau, 1200 m. alt., June 1, 1929, *Cottam, Stanton & Harrison 3991* (P); dry situations, sage association, Pine Valley, 1950 m. alt., June 3, 1929, *Cottam, Stanton & Harrison 4058* (P); St. George, May 13, 1902, *Goodding* (RM); in shrubs, rocky hillside, just outside west entrance to Zion National Park, May 10, 1937, *Hitchcock 2981* (O, UM); w. of St. George, April 16, 1880, *Jones* (P); in gravel, La Verkin, 1020 m. alt., May 8, 1894, *Jones 5187* (F, M, NY, P, RM, UC); red sand, Springdale, 1200 m. alt., May 16, 1894, *Jones 5249* (P); Zion Canyon, May 21, 1923, *Jones* (CA, P, PA, UC); mesa e. of Hurricane, 1125 m. alt., May 3, 1932, *Maguire & Blood 1310* (RM, UC); on gravelly slopes, 3 mi. n. of Toquerville, April 2, 1934, *Maguire, Maguire & Maguire 4753* (RM, WS); Valley of the Virgin, near St. George, May, 1874, *Parry 254* (F, G, M, PA); on limestone, Pine Valley Road, 15 mi. w. of St. George, 1500 m. alt., May 6, 1934, *Stone 166* (NY); on sandstone, 34 mi. from St. George, toward Cedar City, 1530 m. alt., May 9, 1934, *Stone 200* (NY); in sand, Red Hill, St. George, May 2, 1908, *Tidestrom 9266* (M); piñon belt, on slopes between St. George and Beaverdam Mts., May 6, 1919, *Tidestrom 9313* (NY).

ARIZONA. COCONINO CO.: San Francisco Mts., July, 1884, *Lemmon & Lemmon* (UC); Bright Angel Trail, Grand Canyon of the Colorado River, May 6, 1917, *Meiere* (CA); Bright Angel Trail, Grand Canyon, 1908, *Shockley* (D). YAVAPAI CO.: Montezuma Castle National Monument, May 20, 1937, *Cutler 1123* (M); Prescott, June 3, 1929, *Eastwood 17694, in part* (CA); Verde Valley, April 15, 1920, *Jones 119* (G); between Prescott and Ash Fork, May 12, 1931, *McKelvey 2190* (G); Fort Verde, 1884, *Mearns 203, in part* (NY); loose gypsum soil near Montezuma Castle National Monument, May 21, 1935, *Nelson & Nelson 2039* (M). GILA CO.: mesa near Rock and Rye creeks, 990–1050 m. alt., *Collom 74* (M, NY); Roosevelt Dam, April 19, 1917, *Eastwood 6282* (CA); Roosevelt Dam, May 17, 1919, *Eastwood 8734* (CA); San Carlos, April 1, 1935, *Eifrig* (F); hillsides, Globe-Cooley Road, May 6, 1925, *Nelson 10374* (RM, UC); rocky slopes near Roosevelt Lake, May 6, 1935, *Nelson & Nelson 1792* (M, NY); mesas at the foot of the Mazatzal Mts., May 19, 1935, *Nelson & Nelson 1984* (M); San Carlos, April, 1932, *Palmer* (CA); 9 mi. n. of Winkelman, Globe Road, April 28, 1922, *Wiegand & Upton 3046* (F). MOHAVE CO.: vicinity of Kingman, Spring, 1927, *Braem* (D); road to Clay Springs, 900–1200 m. alt., May 15, 1935, *Braem* (D, P); on road to Peach Springs, from Kingman, May 17, 1931, *Eastwood 18463* (CA); Yucca, April 21, 1884, *Jones* (P); Peach Springs, May 26, 1884, *Jones* (P); Chemehuevis, 750 m. alt., April 21, 1903, *Jones* (P); Peach Springs, June, 1884, *Lemmon & Lemmon* (UC). COUNTY NOT DETERMINED: on road to the Mercury Mine, region of Apache Trail, May 6, 1929, *Eastwood 16883* (CA).

NEVADA. CLARK CO.: brushy flat, juniper belt, Kyle Canyon, Charleston Mts., 2100 m. alt., May 10, 1936, *Clokey 7040* (Clokey); same locality, 1400 m. alt., May

15, 1937, *Clokey 7481* (Clokey, M, O); in brush, juniper belt, Harris Springs Road, Charleston Mts., 1800 m. alt., May 17, 1937, *Clokey 7483* (Clokey, M, O); wash, *Covillea* belt, Trout Creek Fan, Charleston Mts., 1700 m. alt., May 8, 1936, *Clokey & Anderson 7139* (Clokey, M, O); in the underbrush, Muddy Range, April 10, 1905, *Goodding 2215* (M, RM); Goodsprings, April 30, 1905, *Jones* (CA, NY, P); Las Vegas into Charleston Mts., 1500 m. alt., May 2, 1934, *Stone 115* (NY). NYE CO.: Rhyolite, 1140 m. alt., April 26, 1907, *Jones* (P). ESMERALDA CO.: Grapevine Mts., June 2, 1891, *Coville & Funston 978* (NY). COUNTY NOT DETERMINED: red sand, St. Joe, 420 m. alt., April 7, 1894, *Jones 5029* (CA, P); between Boulder City and Rhyolite, April 24, 1935, *McCracken* (CA).

CALIFORNIA. INYO CO.: Daylight Pass, May, 1932, *Harrison 5477* (M); twining among shrubs, on ridge above Keane Spring, Amargosa Range, 1140 m. alt., May 9, 1932, *Munz 12595* (M, P, UC, UM); open hill-slopes above spring, Keane Spring, Funeral Mts., 1320 m. alt., May 9, 1932, *Peirson 9942* (UC); Boundary Canyon, California-Nevada Line, May 3, 1937, *Eountree* (CA); Death Valley, April, 1907, *Smith* (UC). RIVERSIDE CO.: rocky slope in high canyon, vicinity of Corn Springs, Chuckwalla Mts., Colorado Desert, 660 m. alt., April 9–12, 1922, *Munz & Keck 4838* (P).

24. Calochortus Dunnii Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 147. 1901.

Calochortus Palmeri var. *Dunnii* Jepson & Ames in Jepson Fl. Calif. **1**: 294. 1921.

Bulb ovoid, with membranaceous coats; stem erect, often branched, not bulbiferous; leaves 1 cm. or less broad, tapering to the tip, reduced upward; inflorescence monochasially 1–4-flowered, its internodes usually very short; flowers broadly campanulate, erect, white or flushed with pink, with a reddish brown spot on each petal above the gland, and sometimes with a smaller, similar spot on each sepal near the base; sepals shorter than the petals, lanceolate, acuminate, usually glabrous; petals obovate, cuneate, usually rounded above, sparsely invested near the gland with short yellow hairs; gland not depressed, more or less circular, densely covered with yellow, hair-like processes; anthers oblong, acute, white, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, 3-angled, erect; seeds not known.

This species differs from its immediate allies in its hair-like gland processes and white petals, which are spotted above the gland. In size and habit, it resembles *C. splendens*, with which it grows, and with which it occasionally hybridizes.

DISTRIBUTION. On dry, stony ridges near Julian, San Diego County, California, southward to the Guadalupe Mountains in northern Lower California.

CALIFORNIA. SAN DIEGO CO.: on chaparral ridges, between Julian and Cuyamaca, June 22, 1903, *Abrams 3810* (G, M, NY, PA); west side of road on rocky, bushy hillside, 2 mi. from Descanso, off the Campo Road, June 15, 1906, *Brandegee* (UC); near Descanso, June 20, 1904, *Brandegee* (UC); Cuyamaca Mts., July 5, 1898, *Dunn* (CA), TYPE COLLECTION; dry, stony slope, "Desert View," s. of Julian, June 29, 1923, *Munz & Harwood 7314* (NY, P); rocky hilltop, 3 mi. s. e. of Julian, June 24, 1938, *Ownbey & Ownbey 1664* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); Cuyamaca, 1350 m. alt., June 11, 1919, *Spencer 1356* (CA, G, NY, P).

LOWER CALIFORNIA. "Northern Lower California," July 10, 1884, *Orcutt 532* (US); Guadalupe Mts., June, 1883, *Orcutt 839* (G).

25. Calochortus Palmeri Watson in Proc. Am. Acad. **14**: 266. 1879.

Calochortus splendens var. *montanus* Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 143. 1901.

Calochortus invenustus var. *montanus* Parish in Bull. So. Calif. Acad. **1**: 124. 1902.

Calochortus montanus Davidson, *ibid.* **9**: 54. 1910.

Calochortus paludicola Davidson, *ibid.* 53.

Calochortus Palmeri var. *paludicolus* Jepson & Ames in Jepson, Fl. Calif. **1**: 294. 1921.

Bulb ovoid, with membranaceous coats; stem erect, often branched, bulbiferous; leaves linear, attenuate, reduced upward; inflorescence monochasially 1–4-flowered, its internodes usually very short; flowers broadly campanulate, white to lavender, sometimes with a brownish spot near the base of each sepal, or on each petal about the gland; sepals equalling or exceeding the petals, lanceolate, acuminate, the tip often curled back, glabrous; petals obovate, cuneate, usually rounded above, sparsely invested near the gland with yellow, flexuous hairs; gland not depressed, more or less circular, densely covered with short, thick, distally knobbed, but unbranched, yellowish processes; anthers oblong, acute or obtuse, white, usually equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, 3-angled, erect; seeds unknown.

Notwithstanding the formidable array of synonyms, *C. Palmeri* is morphologically quite uniform, and is easily

distinguished by its characteristic gland processes. It is perhaps most closely allied to *C. splendens,* but its white anthers and consistently bulbiferous habit, as well as the gland characters, mark it at once. The name, *C. Palmeri,* however, has usually been misapplied to another entity, *C. striatus,* an interpretation which is not in accord with the specimens on which it was based.

DISTRIBUTION. California: in low meadows, "cienegas," Tehachapi, San Gabriel, San Bernardino and San Jacinto mountains.

CALIFORNIA. KERN CO.: Tehachapi, June 24, 1889, *Greene* (UC). LOS ANGELES CO.: in adobe of a cienega, Leonis Valley, May 9–24, 1896, *Davy 2608* (UC). SAN BERNARDINO CO.: flat and low hills, Squint's Ranch, 1600 m. alt., June 5, 1935, *Clokey 6539* (Clokey); openings on flats and slopes, Horsethief Canyon, 1000 m. alt., June 5, 1935, *Clokey & Anderson 6538* (Clokey, F, M, NY, P); wet meadow, Bear Valley, July, 1909, *Davidson 2171* (D), type collection of *C. paludicola* Davidson; moist area under pines, near lake, about 1 mi. w. of Fawnskin, July 6, 1924, *Johnston* (P); grassy swale, south side of Big Bear Lake, San Bernardino Mts., June 29, 1938, *Ownbey & Ownbey 1675* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); Mojave River District, May 25, 1876, *Palmer 527* (F, G TYPE, M, NY, UC); borders of stream, Cox Ranch, north side of San Bernardino Mts., June 14, 1886, *Parish 1857* (G, UC); upper Mojave River, northern base of San Bernardino Mts., May, 1882, *Parish & Parish 1341* (F, G, PA, UO). RIVERSIDE CO.: Strawberry Valley, San Jacinto Mts., 1650 m. alt., June 21, 1910, *Condit* (UC); San Jacinto Mts., 2100 m. alt., Aug., 1880, *Parish & Parish 586* (G); San Jacinto Mts., June, 1897, *Reinhardt* (UC).

26. Calochortus splendens Douglas ex Bentham in Trans. Hort. Soc. Lond. Ser. II. **1**: 411, *pl. 15, fig. 1.* 1834.

Calochortus splendens var. *atroviolaceus* Hort. in Gard. Chron. Ser. III. **18**: 14. 1895; Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 221. 1900.

Calochortus splendens var. *ruber* Hort. ex Purdy & Bailey, *l. c.*

Calochortus splendens var. *major* Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 143. 1901.

Calochortus splendens var. *rubra* Purdy, *l. c.* 144.

Calochortus Davidsonianus Abrams, Illust. Fl. Pac. States **1**: 441. 1923.

Bulb ovoid, with membranaceous coats; stem erect, often branched, rarely bulbiferous; leaves linear, attenuate, reduced upward; inflorescence monochasially 1–4-flowered, its inter-

nodes usually very short; flowers erect, campanulate, lavender, often with a purple spot near the base of each sepal and sometimes with a similar spot on each petal about the gland; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals obovate, cuneate, usually rounded and erose-dentate above, sparsely invested below the middle with slender, more or less flexuous hairs; gland not depressed, naked or usually densely covered with distally much-branched ("fungoid") processes; anthers linear-lanceolate to linear-oblong, obtuse to short apiculate, purple to blue, usually shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, 3-angled, erect; seeds strongly flattened with light-colored, cellular coats.

Calochortus splendens is usually easily distinguished by its characteristic gland processes, but the occasional absence of these is equally characteristic. Both forms are frequently found growing together, and are otherwise indistinguishable. Specimens of this species from Santa Barbara County and southward have fewer, shorter hairs on the face of the petals, but do not appear to differ constantly in any other way. This element has been described as *C. Davidsonianus*, but its single quantitative difference seems hardly of taxonomic significance.

DISTRIBUTION. Dry hills, Colusa County, California, southward in the Coast Ranges to northern Lower California; also on Santa Catalina and the Coronados Islands.

CALIFORNIA. COLUSA CO.: clay soil, above Middle Fork of Stony Creek, 2.5 mi. e. of Bonnie View, e. base of Snow Mt., 510 m. alt., May 14, 1939, *Constance 2491* (UC); on mountains near Fouts Springs, June, 1884, *Rattan 60* (D, G). LAKE CO.: between Burns Valley and Borax Lake, June 9, 1938, *Hoover 3552* (UC). SANTA CLARA CO.: near Llagas Creek, June 6-10, 1909, *Dudley* (D). SAN BENITO CO.: loose soil in sandstone, east slope, *Pinus Sabiniana* belt, 2 mi. n. of Idria, San Carlos Range, South Coast Ranges, 600 m. alt., May 25, 1938, *Constance & Morrison 2265* (O, WS); near Hepsedam Peak, 1899, *Dudley* (D); San Benito, May 16, 1918, *Eastwood 6945* (CA); Loco Flat, San Benito River, 600 m. alt., May 29, 1915, *Hall 9957* (G, UC); Hernandez, June 7, 1903, *Lathrop* (D). MONTEREY CO.: head of Paloma Canyon, about 8 mi. above its confluence with the Arroyo Seco, Santa Lucia Mts., July 1, 1923, *Bacigalupi* (D); Tularcitos Ranch, Carmel Valley, May 15, 1924, *Bacigalupi* (D); San Antonio River, May 7, 1861, *Brewer 568* (UC); Stone Canyon, June 13, 1910, *Condit* (UC); locality uncertain, but presumably near Monterey, "California," *Douglas* (G, NY), TYPE COLLECTION; dry bank by road, above Mission San Antonio, May 13, 1895, *Dudley* (D); grade s. of Tularcitos

Ranch, Santa Lucia Mts., June 10, 1901, *Dudley* (D); Tassajara Hot Springs, June, 1901, *Elmer 3217* (CA, D, M, UO); Santa Lucia Camp, Arroyo Seco River, Santa Lucia Mts., May 23, 1931, *Howell 6533* (CA). SAN LUIS OBISPO CO.: Paso Robles, June 10, 1917, *Abrams 6501* (D); Atascadero, April 30, 1861, *Brewer 507* (G, M, UC, WS); Paso Robles, May 4, 1926, *Eastwood 13811* (CA); 3½ mi. n. e. of Black Mt., S. 1, T. 29 S., R. 15 E., 540 m. alt., May 24, 1937, *Hendrix 212* (UC); roadsides, near Templeton, May 9, 1926, *Wiggins 2056* (D). SANTA BARBARA CO.: Blochman's Ranch, near Santa Maria, June 17, 1906, *Eastwood 488* (CA); Mono Flat Ranger Station, Santa Barbara Forest Reservation, 450 m. alt., July 3, 1923, *Grant 1687, in part* (M, P); Santa Barbara, *Meiere* (CA). VENTURA CO.: dry, sandy soil, Quatal Canyon, near Mt. Pinos, July 2, 1938, *Ownbey & Ownbey 1685* (G, M, O, UC). LOS ANGELES CO.: Bouquet Canyon, 450 m. alt., May 13, 1930, *Clokey, Clokey & Templeton 4627* (Clokey); Topanga Canyon, Santa Monica Mts., June 3, 1916, *Hiatt* (P); Claremont, May 7, 1910, *Pease* (G); Claremont, 450 m. alt., *Steffa* (P); dry, sunny, clay hillside, Liveoak Canyon, San Gabriel Mts., 480 m. alt., April 27, 1934, *Wheeler 2570* (CA, D, UCLA). SANTA CATALINA ISLAND: without exact locality, *Brandegee* (UC); without exact locality, May 15, 1890, ex herb. *Brandegee* (G); grassy slope, Empire Landing, 60 m. alt., May 12, 1928, *Dunkle 1922* (P); Isthmus, May 29, 1927, *Jones* (P); without exact locality, June 12, 1921, *Knopf 213* (F); Isthmus, June, 1922, *Knopf 446* (F); open fields at the Isthmus, May 16, 1920, *Nuttall 216* (F); highlands between Summit and Middle Ranch Canyon, June 4, 1920, *Nuttall 598* (F); dry, high hills, Avalon, May, 1896, *Trask* (M, NY, UC). SAN BERNARDINO CO.: brushy flat, Devore Cutoff, 460 m. alt., May 19, 1935, *Clokey 6540* (Clokey, F, M, NY, P); Arrowhead Springs, May 10, 1891, *Fritchey 39* (M); Mill Creek Canyon, near Skinner, June 15, 1901, *Grant* (D); Arrowhead Hot Springs, San Bernardino Mts., May 24, 1906, *Grant 6647* (D); Redlands, May, 1906, *Greata 446* (CA); between Victorville and Mojave, May 24, 1926, *Hart 26* (CA); Cajon Canyon, June, 1928, *Jones* (F, P); hills near Old San Bernardino, May 10, 1889, *Parish 2075* (F); dry mesas, San Bernardino Valley, n. of San Bernardino, 300 m. alt., June 8, 1917, *Parish 11334* (UC); Mentone, May, 1903, *Williamson* (PA). RIVERSIDE CO.: Elsinore, May, 1901, *Abrams* (D); near Idylwild, June 24, 1932, *Epling* (UCLA); 4 mi. above Corona, Temescal Canyon, June, 1933, *Epling & Ewan* (D, M, UC, UCLA); canyon of the San Jacinto River, San Jacinto Mts., 900 m. alt., June 8, 1901, *Hall 2014* (UC); dry hillside, San Jacinto River Canyon, May 30, 1917, *Jenkins & Street 1953* (D, P); Banning, 690 m. alt., May 11, 1903, *Jones* (P); Menifee, May, 1893, *King* (UC); dry soil near road, mouth of San Jacinto Canyon, 450 m. alt., May 19, 1922, *Munz & Johnston 5411* (P); dry ridge, Glen Ivy Trail to Santiago Peak, Santa Ana Mts., 1440 m. alt., June 14, 1923, *Munz & Keck 7094* (P). ORANGE CO.: Trabuco Canyon, June 16, 1901, *Abrams 1798* (D); El Modena, March, 1899, *Bowman* (D); Laguna Beach, May, 1921, *Campbell 1* (CA); bluffs along shore, Laguna Beach, May 5, 1916, *Crawford* (D, P); hillsides, Santa Ana River Canyon, May 3, 1919, *Munz, Street & Williams 2625* (D, P, PA); open, dry slopes and hillsides, Arch Beach, May, 1903, *White 3* (UC). SAN DIEGO CO.: grassy slopes, between Onofre Mts. and the sea, April 19, 1903, *Abrams 3275* (G, M, NY, P, PA), type collection of *C. Davidsonianus* Abrams; Mission Hills, San Diego, May 5, 1903, *Abrams 3401* (D, G, M, NY, P, PA); on dry ridges, Jacumba, May 31, 1903, *Abrams 3666* (D, NY); grassy slopes, Cuyamaca P. O., 1410 m. alt., June 23, 1903, *Abrams 3817*

(D, G, M, NY); Del Mar, May 11, 1905, *Brandegee* (UC); hillsides and mesas, San Diego, May, 1906, *Brandegee* (UC); Descanso, June 16, 1906, *Brandegee* (UC); in hard soil, San Diego, May 20, 1903, *Brandegee 3420* (F, G, M, NY, P, UC); Warners Hot Springs, July, 1913, *Buttle* (CA); Otay, April 24, 1904, 7 m. alt., *Chandler 5111* (NY); old clearings, foothills, Bird Rock, April 11, 1914, *Clements & Clements 281* (F, G, M, NY, PA); Las Paderes Ranch, Sweetwater Valley, June 6, 1888, *Deane* (G); Tia Juana, April 24, 1913, *Eastwood 2933* (CA); Descanso, June 26, 1919, *Eastwood 9182* (CA, G); Descanso, June 20, 1932, *Epling, Darsie, Knox & Robison* (D, M, NY, UC, UCLA); Harper Ranch, near Cuyamaca Lake, June 23, 1932, *Epling, Darsie, Knox & Robison* (CA, D, M, RM, UC, UCLA); Hell Hole Canyon, near Borego, April 5–7, 1932, *Epling & Robison* (D, UC, UCLA); Guatay Mt., June 26, 1935, *Epling & Robison* (UCLA); wooded hills, open spaces, near Julian, 1300 m. alt., June 6, 1932, *Fosberg 8283* (P); Ostrich Farm, San Diego, May 5, 1906, *Grant* (D); Santa Ysabel, May 20, 1893, *Henshaw* (G); at edge of chaparral, San Onofre Canyon, 165 m. alt., May 16, 1929, *Hitchcock* (P); sandy flats, 4 mi. e. of Pala, May 11, 1930, *Howell 4857* (CA); mountain trail, La Jolla, May 25, 1911, *Jenks* (UCLA); Cuyamaca Lake, May 30, 1926, *Jones* (CA, P); Santa Ysabel, June 11, 1932, *Jones* (UC); Cuyamaca Lake, June 11, 1932, *Jones* (UC); Pala, May 10, 1934, *Jones* (P); Jacumba, Laguna Mts., June 10, 1917, *McGregor 996* (D); Escondido, April, 1927, *Meyer 110* (UC); burn in chaparral, Tecate Mt., May 10, 1924, *Munz 8033* (P); dry ridge, Palomar Mts., 1500 m. alt., June 22, 1924, *Munz 8218* (P); dry slope, Doane Valley, Palomar Mts., 1500 m. alt., June 23, 1924, *Munz 8321* (G, P); dry chaparral burn, 6 mi. n. of Santa Ysabel, May 20, 1925, *Munz 9807* (P); dry hillside, near Fallbrook, 225 m. alt., May 15, 1920, *Munz & Harwood 3855* (D, P, PA, RM); dry, gentle slope, 8 mi. n. of Descanso, June 27, 1923, *Munz & Harwood 7170* (P); dry, gravelly, brush-covered hills, 3 mi. n. w. of Pine Valley, June 24, 1938, *Ownbey & Ownbey 1660* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UM, UO, US, WS); hillsides, Soledad Mt., near La Jolla, May 1, 1935, *Purer 6523* (M); hillside, near Ramona, June 8, 1935, *Purer 6676* (M); dry soil, Camp Kearney Mesa, May 29, 1937, *Purer 7267* (M); Point Loma, May 16, 1897, *Reed* (P); La Jolla, April 26, 1895, *Snyder* (F); on sunny, sandy slopes, vicinity of San Diego, 90 m. alt., April 21, 1916, *Spencer 18* (G, UC); dry hills, Mesa Grande, 1005 m. alt., May 29, 1919, *Spencer 1153* (CA, G, NY, P); dry hills, Mesa Grande, 990 m. alt., June 1, 1919, *Spencer 1354* (G); in desert sand, Colorado Desert, May 16, 1920, *Spencer 1590* (P); dry slopes above Descanso Creek, 3½ mi. above Descanso, 1110 m. alt., May 30, 1931, *Wolf 2206* (D); San Luis Rey River, ½ mi. below Henshaw Dam, 1780 m. alt., May 30, 1931, *Wolf 2225* (UC), *2226* (D).

Lower California. Coronados Islands, *Anthony* (UC); Valledenos Creek, May 4, 1893, *Brandegee* (UC); clay and rock hillside, 15 mi. n. of Ensenada, 300 m. alt., April 3, 1925, *Canby* (P); north end of east island, top of dry ridge, Coronados Islands, 210 m. alt., March 29, 1921, *Cowles 1* (P); gravelly plains, San Quintin, April 8, 1936, *Epling & Stewart* (D, UCLA); All Saints Bay, April, 1882, *Fish* (G); Tecate, April 10, 1923, *Gallegos 925* (US); ranch, 29 mi. s. w. of Tia Juana, April 13, 1925, *Jones* (P).

27. Calochortus striatus Parish in Bull. So. Calif. Acad. 1: 122. 1902.

? *Calochortus comosus* A. Nelson in Bot. Gaz. **47**: 425. 1909.[34]

Bulb ovoid, with membranaceous coats; stem erect, sometimes short, usually branched, not bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–5-flowered, subumbellate; flowers campanulate, erect, lavender with conspicuous purple veins; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals obovate, cuneate, usually rounded and erose above, sparsely invested near the gland with slender, flexuous hairs; gland not depressed, oblong, densely covered with slender, hair-like processes; anthers oblong, obtuse or acute, yellowish, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, 3-angled, erect; seeds strongly flattened, with light-colored, hexagonally reticulate coats.

This species is distinguished by its striate petals and hair-like gland processes. In the California manuals and floras it is described as *C. Palmeri*, but that name was originally applied to a different entity.

DISTRIBUTION. In low alkaline meadows about springs, near Las Vegas, Nevada, and on the Mojave Desert in southern California, particularly along its southern edge.

NEVADA. CLARK CO.: Las Vegas, 300 m. alt., April 29, 1905, *Jones* (D, P).

CALIFORNIA. KERN CO.: dry soil, Steban Miranda's Rancheria, 2 mi. n. e. of Weldon, 900 m. alt., June 1, 1933, *Voegelin 221* (UC). LOS ANGELES CO.: dry places about Lancaster, May, 1909, *Brandegee* (UC); Lancaster, June, 1902, *Elmer 4164* (D). SAN BERNARDINO CO.: in cienega, Cushenbury Spring, June 17, 1923, *Berry* (D); Twenty Nine Palms, May 17, 1902, *Brandegee* (UC); in slightly alkaline meadow about springs, Rabbit Springs, Lucerne Valley, Mojave Desert, 870 m. alt., June 10, 1930, *Johnston 3777* (P); Whiskey Spring, Cushenbury Canyon, May 12, 1926, *Jones* (CA, D, NY, P); alkaline meadow, Cushenbury Spring, Mojave Desert, 1260 m. alt., June 13, 1922, *Munz 5740* (Clokey, P, UC); dry meadow, Cushenbury Spring, Mojave Desert, June 30, 1938, *Ownbey & Ownbey 1677* (G, Kew, M, O, RM, UC); alkaline meadows, Rabbit Springs, Mojave Desert, 810 m. alt., June 1, 1901, *Parish 5000* (D, G, NY, P); Rabbit Springs, Mojave Desert, May, 1882, *Parish & Parish 1342* (F, G, M, PA), TYPE COLLECTION; along mesa above springs, Box S Springs, 1065 m. alt., May 14, 1924, *Peirson 4563* (D); alkaline meadow, Cushenbury Spring, May 24, 1922, *Pierce* (P).

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[34] The type specimen of *C. comosus* has not been located, but, from the original description, it seems likely to be this species.

28. Calochortus monanthus Ownbey, n. sp.[35]

Bulb ovoid, with membranaceous coats; stem erect, unbranched, bulbiferous; leaves a centimeter or less broad, attenuate, reduced upward; inflorescence 1-flowered, the bracts opposite and linear-attenuate; flower turbinate-campanulate, long-pedicellate, pinkish, with a Λ-shaped, dark red spot on each petal above the gland; sepals shorter than the petals, narrowly lanceolate, attenuate, glabrous; petals obovate, cuneate, rounded and erose above, or with a short acumination, invested near the gland with a few flexuous hairs; gland not depressed, oblong, densely covered with slender, hair-like processes; anthers linear-lanceolate, short-apiculate, longer than the basally dilated filaments; ovary linear, not winged, tapering to a trifid stigma; fruit and seeds not known.

Calochortus monanthus is a fourth unique and unquestionably valid species from the Siskiyou Region of northern California and adjacent Oregon. Like the others, *C. Greenei*, *C. Howellii* and *C. persistens*, it is apparently very restricted in its distribution, having been collected but once, over sixty years ago. Like them, also, it apparently has no immediate allies. Its one-flowered habit, long pedicels, turbinate-campanulate flowers, and particularly the nature of the gland, distinguish it at once.

DISTRIBUTION. California: known only from the type locality.

CALIFORNIA. SISKIYOU CO.: meadow along the Shasta River, near Yreka, June 24, 1876, *Greene 887* (F, G, M TYPE, PA).

29. Calochortus venustus Douglas ex Bentham in Trans. Hort. Soc. Lond. Ser. II. 1: 412, *pl. 15, fig. 3.* 1834.

[35] **Calochortus monanthus** sp. nov., bulbo ovoideo membranaceo-tunicato; caule erecto simplici bulbifero; foliis usque ad 1 cm. latis attenuatis superioribus reductis; inflorescentia uniflora, bracteis oppositis lineari-attenuatis; flore turbinato-campanulato longe-pedicellato roseolo, in quoque petalo supra glandulam macula Λ-formi rubida; sepalis petalis brevioribus anguste lanceolatis attenuatis glabris; petalis obovatis cuneatis, apice rotundis erosisque aut brevi-acuminatis, prope glandulam pilis paucis flexuosis praeditis; glandula non depressa oblonga, processis gracilibus filiformibus dense vestitis; antheris lineari-lanceolatis brevi-apiculatis, filamentis basilariter dilatatis longioribus; ovario lineari non alato, stigmate trifido; capsula seminibusque ignotis.

Calochortus venustus var. *purpureus* Baker in Gard. Chron. N. S. **8**: 72. 1877; Van Eeden, Album, *t. 75, fig. 5*. 1877.

Calochortus venustus var. *purpurascens* Watson in Proc. Am. Acad. **14**: 266. 1879; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 141. 1901.

Calochortus purpurascens Purdy, *l. c.* 139, as synonym.

Calochortus venustus var. *Caroli* Cockerell in Nature **67**: 235. 1903.

Calochortus venustus var. *roseus* Reuthe in Gartenflora **35**: 116. 1886.

Calochortus roseus Hort. in Gard. Chron. Ser. III. **18**: 14. 1895.

Calochortus venustus var. *pictus* Hort., *l. c.*

Calochortus pictus Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 141. 1901, as synonym.

Calochortus venustus var. *sanguineus* Hort. ex Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 221. 1900.

Calochortus venustus var. *eldorado* Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 141. 1901.

Calochortus venustus var. *sulphureus* Purdy, *l. c.*

Bulb ovoid, with membranaceous coats; stem erect, usually branched, bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–3-flowered, subumbellate; flowers erect, campanulate, white to yellow, purple or dark red, each petal marked with a conspicuous, median, dark red blotch, and often with a second, paler blotch above the first; sepals about equalling the petals, narrowly lanceolate, attenuate, curled back at the tip, glabrous; petals obovate, cuneate, usually rounded and obtuse above, sparingly invested near the gland with slender hairs; gland not depressed, more or less quadrate in outline, densely covered with short, hair-like processes; anthers linear-lanceolate to linear-oblong, acute or obtuse, usually about as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, acute, 3-angled, erect; mature seeds unknown.

Calochortus venustus is infinitely variable in the color and markings of the flowers, but appears to represent a very nat-

ural entity. In a given locality, one variant may occur more frequently, but usually not to the exclusion of all others, while a few miles away, another form may predominate. The species is quite constantly distinguished by its quadrate gland, but some color forms are otherwise very close to *C. superbus*.

DISTRIBUTION. California: usually in light, sandy soil, Sierra Nevada, from Eldorado County to Kern County, and in the Coast Ranges from the vicinity of San Francisco Bay to Los Angeles County.

CALIFORNIA. AMADOR CO.: Jackson, 1892, *Hansen 1126* (UC); Pine Grove, 750 m. alt., June, 1895, *Hansen 1251* (D, M). CALAVERAS CO.: hillside above North Fork of Calaveras River, 3 mi. w. of San Andreas, 300 m. alt., May 21, 1927, *Stanford 314* (P, RM); near Milton, May 14, 1923, *Steinbeck* (CA). TUOLUMNE CO.: Keltz Mine, June 7, 1895, *Blasdale* (UC); foot of grade below Confidence, June 15, 1937, *Hoover 2453* (O); near Confidence, July 1, 1923, *Steinbeck* (CA); in sunny places, Bear Creek, 300 m. alt., May 6, 1919, *Williamson 41* (CA, Clokey, D, NY, P, RM). MARIPOSA CO.: El Portal, May 20, 1925, *Augsburg* (CA); between Colfax Springs and Crockers, Yosemite National Park, 900-1350 m. alt., July, 1901, *Evans* (UC); Wawona Road, near Alder Creek, Yosemite National Park, 1500 m. alt., June 18, 1911, *Hall 8988* (UC); Meadow Road, Wawona, 1200 m. alt., July 25, 1923, *Howell 156* (CA); Wawona Road to Yosemite, at Alder Creek, Yosemite Park, 1500 m. alt., June 15, 1924, *Howell 413* (CA); above Coulterville, May, 1932, *Seale* (CA). MADERA CO.: rocky, sandy loam, Clark Administrative Site, Sierra National Forest, S. 28, T. 8 S., R. 22 E., 750 m. alt., June 15, 1933, *Hormay H-155* (UC). FRESNO CO.: Pine Ridge, June, 1910, *Brandegee* (UC); thin, rocky soil, with granite boulders and bushes, grassy north slope, *Quercus Douglasii-Aesculus* association, 1 mi. n. w. of Squaw Valley, on road to General Grant Park, Sierra Nevada Foothills, 510 m. alt., May 9, 1938, *Constance 2227* (O, WS); Base Camp, junction of North and South Forks of Kings River, April 10, 1923, *Duncan 76* (D); Cascada, 1500 m. alt., June 25, 1917, *Grant 1007, in part* (D); Pine Ridge, 1500 m. alt., June 15–25, 1900, *Hall & Chandler 245* (D, UC). TULARE CO.: vicinity of Homers Nose, region of Sequoia National Forest, 2700 m. alt., July 11, 1897, *Dudley 1775* (D). KERN CO.: Grapevine Grade, Tejon Pass, April 30, 1927, *Abrams 11667* (Clokey, D, P); Tejon Mts., July 7, 1891, *Coville & Funston 1176* (D), *1177* (NY); hill near Guerilla Creek, vicinity of Poso Creek Valley, July 9, 1895, *Dudley 578* (D); field on Taylor's Ranch, near Gorman's, Tejon Pass, Mt. Pinos Region, June 16, 1896, *Dudley & Lamb 4551* (D); Cuddy Canyon, Mt. Pinos Region, June 18, 1896, *Dudley & Lamb 4582* (D); pass to San Emigdio, Mt. Pinos Region, June 18, 1896, *Dudley & Lamb 4584* (D); south slope, Tejon Pass, 1260 m. alt., June, 1905, *Hall 6265a, 6265b* (UC); dry soil, east slope, Greenhorn Range, 1350 m. alt., June 2–10, 1904, *Hall & Babcock 5064* (UC); rocky wash, Kern Canyon, 7 mi. above Kernville, 720 m. alt., May 13, 1930, *Howell 5055* (CA); Kernville, May, 1876, *Kennedy* (F, G, type of *C. venustus* var. *purpurascens* Watson); baked roadside, near Isabella, June 1, 1935, *MacFadden 14163* (CA); sandy soil in pine-sagebrush association, north of Mt. Pinos, July 2, 1938, *Ownbey & Ownbey 1686* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); pine-sagebrush association, near head of Cuddy Valley, T. 9 N., R. 21 W., July 3,

1938, *Ownbey & Ownbey 1689* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); grassy hillsides, Fort Tejon, June, 1887, *Parish* (F, G, NY); adobe soil, from Lebec through the San Emigdio Range to Maricopa, 900–1250 m. alt., June 19, 1937, *Silvear* (UC); dry hills, 2 mi. n. of Weldon, 900 m. alt., May 20, 1933, *Voegelin 211* (UC). SAN JOAQUIN CO.: Linden, May, 1896, *Gunnison* (UC). CONTRA COSTA CO.: near spring, 4½ mi. from summit, Mt. Diablo, May 25, 1921, *Abrams 8054* (D); Mt. Diablo, May 30, 1915, *Eastwood 4445* (CA); Nortonville, May 12, 1931, *Howell 6471* (CA); Mt. Diablo, May 15, 1899, *Purdy* (G, NY, UO). ALAMEDA CO.: Lake Chabot, San Leandro, June, 1899, *Carruth* (CA); Mocho Creek (Cedar Mt.), May, 1903, *Elmer 4366* (CA, D, M, NY, UO); grassy hill-slopes, between Corral Hollow and Tesla, May 17, 1930, *Ferris 7879* (D, P, UC); grassy hill-slope, Tesla, May 17, 1930, *Ferris 7886* (D). SAN MATEO CO.: serpentine, back of Redwood City, June 1, 1930, *Abrams 7499* (D); Portola, July, 1903, *Elmer 4763* (D, M, NY, UC); serpentine, back of Redwood City, June 1, 1920, *Hichborn 275* (M); hills near Redwood City, June 5, 1932, *Seale* (CA); dry ground, Crystal Springs Lake, June 30, 1913, *Suksdorf 371* (G). STANISLAUS CO.: Del Puerto Canyon, May 13, 1938, *Hoover 3414* (O). SANTA CLARA CO.: San Jose, May, 1901, *Abrams* (D); Pachecos Pass, June 25, 1862, *Brewer 1295* (G, M, UC, WS); Mt. Hamilton, June, 1900, *Carruth* (CA); Palo Alto, 1893, *Dudley* (D); San Juan Hills, May 27, 1895, *Dudley 4012* (D); near Coyote Creek, May 31, 1895, *Dudley 4122* (D); serpentine hills, near Coyote, 60 m. alt., May 17, 1918, *Ferris 823* (D); Mt. Hamilton Road, near Grand View, 450 m. alt., May 30, 1907, *Heller 8601* (D, F, G, M, NY, PA); serpentine, Jasper Ridge, June 4, 1921, *Mason* (D); San Juan Hills, near San Jose, May 7, 1895, *Patterson* (D); dry slope, San Antonio Creek, Burnt Hills, Mt. Hamilton Range, 600 m. alt., May 26, 1935, *Sharsmith 3204* (O); Alum Rock Canyon, 300 m. alt., May, 1905, *Williamson* (PA). SANTA CRUZ CO.: Santa Cruz, June, 1881, *Jones* (P); Adobe Creek Road, 1 mi. below Mt. Herman, 600 m. alt., June, 1910, *Pendleton 1480* (UC). SAN BENITO CO.: Panoche Pass, April 29–March 1, 1921, *Abrams & Borthwick 7939* (D, NY, P, RM); New Idria, April 29–March 1, 1921, *Abrams & Borthwick 7971* (D, P); near New Idria, May 31, 1899, *Dudley* (D); Lone Tree Road, lower canyon of Arroyo Dos Picachos, May 28, 1938, *Hoover 3488* (O); Arroyo Dos Picachos, May 28, 1938, *Howell 13814* (CA); Hernandez, May 25, 1903, *Lathrop* (D); Pinnacles, May 16, 1926, *Rodde* (CA); The Pinnacles, May 31, 1926, *Sutliffe* (CA). MONTEREY CO.: Nacimiento River, May 7, 1861, *Brewer 538* (CA, G, M, UC, WS); locality uncertain, but presumably near Monterey, "Nova California," 1833, *Douglas* (G, NY), TYPE COLLECTION; Santa Lucia Mts., near Jolon, May 13, 1895, *Dudley* (D); sandy flat, 12.5 mi. s. e. of Jolon, Santa Lucia Mts., 320 m. alt., May 10, 1935, *Keck & Stockwell 3228* (D); Santa Lucia Mts., June, 1898, *Plaskett 148* (NY). SAN LUIS OBISPO CO.: Paso Robles, May 7, 1899, *Barber* (P, UC); Santa Lucia Mts., May 22, 1899, *Barber* (UC); Paso Robles, June, 1906, *Carruth* (CA); Trout Creek, May 31, 1908, *Condit* (UC); roadside, Morro, June 13, 1911, *Condit* (UC); Cholame, May 5, 1926, *Eastwood 13905* (CA); along old road to Poyo, May 17, 1928, *Eastwood 15144* (CA); Pettitts Canyon, May 19, 1928, *Eastwood 15169* (CA); *Pinus Sabiniana-Juniperus californica* association, La Panza, April 26, 1934, *Keck 2815* (D, F, M, P, UC); Paso Robles, June, 1887, *Lemmon* (G, UC); Paso Robles, *Purdy* (G, P, UC); San Luis Valley, June 10–30, 1882, *Summers 844* (UC), *844a* (D). SANTA BARBARA CO.: trail to Zaca Peak,

June 21, 1906, *Eastwood 595* (CA); Zaca Peak Ridge, June 28, 1906, *Eastwood 753* (CA); near Santa Barbara, *Miles* (NY). VENTURA CO.: Sulphur Mt. Spring, Sulphur Mt., 300–600 m. alt., June 1, 2, 1908, *Abrams & McGregor 44* (D, G, NY, P); brushy hillside, Cuyama River, 1150 m. alt., May 22, 1935, *Clokey & Anderson 6543* (Clokey); Griffins, July, 1902, *Elmer 3812* (D, M, NY, P); hard-baked adobe ground, mouth of Matilija Canyon, Ojai Valley, April 18, 1932, *Fosberg 7986* (M, UCLA); Mt. Pinos, July 4, 1922, *Hart 18* (CA); near Frazer Mt. Park, May 27, 1928, *Hilend 319* (UCLA); Camarilla, April 27, 1926, *Jones* (D); Cuyama Canyon, April 28, 1926, *Jones* (D); dry flat, Upper Sespe Creek, n. of Wheelers Hot Springs, 1050 m. alt., May 1, 1934, *Munz 13224* (P). LOS ANGELES CO.: Liebre Mt., 1440 m. alt., June 20–23, 1908, *Abrams & McGregor 361* (D, NY); Newhall, May 15, 1916, *Evermann* (CA); grassy slope of oak glade, mouth of Pico Canyon, near Newhall, 360 m. alt., May 17, 1930, *Ewan 5514* (D); road to Mt. Pinos, 1 mi. w. of juncture with Ridge Route, May 27, 1928, *Hitchcock* (P); Castaic, Ridge Road, April 29, 1934, *Jones* (P); near Power Plant No. 1, San Francisquito Canyon, June 12, 1922, *Moxley 1114* (RM); dry slope, Mint Canyon, n. of San Gabriel Mts., May 25, 1923, *Munz 6791* (NY, P, UC); burned-over area in chaparral, Bouquet Canyon, near Saugus, 990 m. alt., June 9, 1923, *Munz 6927* (NY, P); dry hillside, Ranger Station, Ridge Road, s. of Tejon Pass, June 9, 1923, *Munz 6927a* (P); dry slope, southern end of Ridge Route to Bakersfield, May 15, 1922, *Pierce* (P); Grapevine Canyon, near San Fernando, May 13, 1915, *Trowbridge* (CA).

30. Calochortus superbus Purdy ex Howell in Leafl. West. Bot. **1**: 11. 1932.

Calochortus venustus var. *citrinus* Baker in Journ. Linn. Soc. Lond. Bot. **14**: 310. 1874.

Calochortus luteus var. *citrinus* Watson in Proc. Am. Acad. **14**: 265. 1879, as to name-bringing synonym.

Calochortus venustus var. *lilacinus* Baker in Gard. Chron. N. S. **8**: 70. 1877; Van Eeden, Album, *t. 75, fig. 1.* 1877.

Calochortus luteus var. *oculatus* Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 220. 1900; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 138. 1901, not Watson, 1879.

Calochortus venustus var. *oculatus* Hort. acc. Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 220. 1900, as synonym.

Calochortus luteus var. *robusta* Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 139. 1901.

Calochortus venustus var. *robusta* Hort. acc. Purdy, *l. c.* as synonym.

Calochortus venustus var. *superbus* Bailey & Bailey, Hortus, p. 113. 1930.

Calochortus superbus var. *pratensis* Purdy ex Howell in Leafl. West. Bot. 1: 12. 1932.

Bulb ovoid, with membranaceous coats; stem erect, often branched, bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–3-flowered, subumbellate; flowers erect, campanulate, white to yellowish or lavender, the petals and sepals usually pencilled with purple below, and marked with a conspicuous, median, reddish brown or purple blotch, surrounded by a zone of bright yellow; sepals usually shorter than the petals, lanceolate, attenuate, glabrous; petals obovate, cuneate, usually rounded and obtuse above, sparingly invested near the gland with short hairs; gland not depressed, linear, more or less Λ-shaped, densely covered with short, hair-like processes; anthers linear-lanceolate to linear-oblong, acute or obtuse, about as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, acute, 3-angled, erect; mature seeds unknown.

Calochortus superbus is closely related to *C. luteus* and *C. Vestae*, but is usually readily distinguished by its flower-color and Λ-shaped gland. It hybridizes with the former in localities where the two come into contact, but neither species seems to have been greatly influenced by hybridization. In flower-color, it often closely resembles certain phases of *C. venustus*, but seems constantly different in gland-shape.

DISTRIBUTION. California: in dry meadows, Sierra Nevada, from Shasta County southward to Kern County, and in the North Coast Ranges, from Shasta County southward to Lake County; also apparently in the Palomar Mountains, San Diego County.

CALIFORNIA. SHASTA CO.: fields in digger pine belt, Round Mt., June 23, 1929, *Applegate 5847* (D, UC); Ridge Road, near Oak Run, May 5, 1900, *Baker* (UC); Oak Run, May 21, 1894, *Baker & Nutting* (UC); Morleys Station, May 22, 1894, *Baker & Nutting* (D, RM, UC); Montgomery Creek, June 7, 1923, *Bethel* (CA); Goose Valley, June 29–July 11, 1912, *Eastwood 795* (CA, Clokey, G, NY); dry, gravelly hills, western part of Redding, May 25, 1905, *Heller 7845* (D, F, G, M, NY, PA, UC); near Redding, May, 1931, *Rose* (CA); Anderson, May 28, 1913, *Smith 323* (CA, G); Redding, May 21, 1914, *Smith 708* (CA); Anderson, May, 1915, *Smith* (CA). TEHAMA CO.: Red Bluff, May 19, 1915, *Smith* (CA); Red Bluff, June, 1917, *Wickes* (CA). BUTTE CO.: De Sabla, June 6, 1917, *Edwards* (Clokey, D, NY, P, UO). YUBA CO.: Brownsville, ex herb. *Birmingham* (NY). NEVADA CO.: Lake City, Sierra Nevada, July, 1867, *Davis 67* (NY); Nevada City, June 20–22, 1912, *Eastwood 595* (CA, Clokey, G, M, NY). PLACER CO.: Applegate, June, 1899, *Smith*

(RM). AMADOR CO.: near Plymouth, June 6, 1903, *Gross 223* (D); New York Falls, Agricultural Station, 600 m. alt., June, 1895, *Hansen 1250* (D); Sutter Creek, May 15, 1918, *Wood* (D). CALAVERAS CO.: Reservoir, May 18, 1887, *Smith* (PA). TUOLUMNE CO.: 3 mi. n. of Keystone, June 3, 1937, *Hoover 2369* (O); foot of grade below Confidence, June 15, 1937, *Hoover 2454* (O); dry meadow, Mather, 1350 m. alt., July 15, 1923, *Munz 7337* (P); mountain meadow, Mather, July 15, 1927, *Price* (D). MARIPOSA CO.: meadow near Sentinel Hotel, Yosemite Valley, Yosemite National Park, 1200–1350 m. alt., July 6, 1911, *Abrams 4645* (D, G, NY, P); Yosemite Valley, Yosemite National Park, Summer, 1902, *Bacon* (D); Hell Hollow, near Bagby, Merced River Canyon, May 11, 1929, *Branson* (CA TYPE, UC); Yosemite Valley, 1500–2400 m. alt., July 6, 1901, *Grant* (D); meadows near Stoneman Bridge, Yosemite Valley, Yosemite National Park, 1170 m. alt., July, 1911, *Hall* (UC); Yosemite Meadows, Yosemite National Park, 1200 m. alt., July 15, 1911, *Hall 9122* (UC); meadows, vicinity of Hog Ranch, Yosemite National Park, 1410 m. alt., July, 1902, *Hall & Babcock 3307* (UC); in dryish meadow, near Indian Bridge, Wawona, 1200 m. alt., July 22, 1923, *Howell 130* (CA); grassy opening in pine-oak forest, 5 mi. from Mariposa, on road to Briceburg, June 8, 1931, *Howell 6675* (CA, type of *C. superbus* var. *pratensis* Purdy); damp meadow, Yosemite Valley, Yosemite National Park, 1200 m. alt., June 30, 1925, *Keck 173* (P). MADERA CO.: 2 mi. n. e. of Raymond, May 29, 1938, *Hoover 3520* (O); near Raymond, May 29, 1938, *Howell 13863* (CA). FRESNO CO.: Base Camp, junction of North and South Forks of Kings River, May 5, 1923, *Duncan* (Clokey); Big Sandy Creek, June, 1915, *McDonald* (CA); Big Creek Region, July, 1915, *McDonald* (CA); Big Sandy Valley, June 1, 1932, *McDonald* (CA). TULARE CO.: Lemon Cove, Three Rivers Road, 3 mi. w. of Three Rivers, April 20, 1925, *Bacigalupi 1187* (D, P); near Milo, April 5, 1900, *Dudley* (D); road to Mineral King, about 10 mi. from the General's Highway, May 22, 1933, *Holman* (UC). KERN CO.: decomposed granite, 15 mi. n. of Bakersfield, Greenhorn Range, 360 m. alt., April 10, 1932, *Benson 3255* (D, UC); hills near Glenville, Greenhorn Range, 960 m. alt., May 15, 1930, *Howell 5161* (CA); Greenhorn Mts., May 20, 1926, *Weston 151* (CA). SAN DIEGO CO.: edge of dry meadow, Doane Valley, Palomar Mts., 1500 m. alt., June 23, 1924, *Munz 8319* (P). MENDOCINO CO.: hills near Covelo, June 5, 1928, *Eastwood 15187, in part* (CA, F); Potter Valley, June 15, 1921, *Holman* (D); Ridgewood Grade on the Redwood Highway, 570 m. alt., May 24, 1927, *Kildale 3173* (D). LAKE CO.: Siegler Springs, May 18, 1924, *Blankinship* (CA); open hillsides, Dells of Cold Creek, Kelseyville, June 10, 1929, *Blankinship* (M). COUNTY UNCERTAIN: "California," *Bridges 284* (Kew, type of *C. venustus* var. *citrinus* Baker).

31. Calochortus Vestae Hort. in Gard. Chron. Ser. III. **18**: 14. 1895 (spelled "*Vesta*"); Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 139. 1901.

Calochortus venustus var. *Vesta* Hort. in The Garden **46**: 394, *pl. 986, fig. 2.* 1894; Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 221. 1900.

Calochortus luteus var. *Vestae* Jepson, Fl. Calif. **1**: 295. 1921.

Calochortus venustus var. *brachysepalus* Regel in Gartenflora **25**: 130, *t. 865*. 1876.

Calochortus luteus var. *oculatus* Watson in Proc. Am. Acad. **14**: 265. 1879, as to probable type.

? Calochortus oculatus Hort. in Gard. Chron. Ser. III. **18**: 14. 1895.

Bulb ovoid, with membranaceous coats; stem erect, stout, often branched, strongly bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–3-flowered, subumbellate; flowers erect, campanulate, white to purplish, the petals pencilled with red or purple below, and marked with a conspicuous, median, reddish brown blotch, surrounded by a pale yellow zone; sepals usually shorter than the petals, narrowly lanceolate, attenuate, glabrous; petals obovate, cuneate, usually rounded and obtuse above, sparingly invested near the gland with short hairs; gland not depressed, transverse, more or less doubly lunate, densely covered with short, hair-like processes; anthers linear-oblong, obtuse or acute, about as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, acute, 3-angled, erect; mature seeds unknown.

This species is distinguished from *C. superbus*, its nearest ally, by its larger size, more strongly bulbiferous habit, and particularly by its doubly lunate gland. The petal-markings in the two species are occasionally identical, but for the most part, *C. Vestae* has a much larger blotch which sometimes extends entirely across the petal. Cytologically, *C. Vestae* is a tetraploid (2n = 28), but its differences do not seem to be entirely due to the doubling of the chromosome complement.

DISTRIBUTION. California: in heavy clay soils, North Coast Ranges, from Humboldt County southward to Napa and Sonoma counties.

CALIFORNIA. HUMBOLDT CO.: near Bridgeville, June, 1882, *Rattan* (D); northwest slope, lower foothills of Buck Mt., 750 m. alt., June 17, 1913, *Tracy 4147* (UC); Laribee Creek, Bosworth's Ranch, 450 m. alt., June 19, 1916, *Tracy 4713* (UC). MENDOCINO CO.: Bell Springs, July 10, 1916, *Abrams 5944* (D, NY); Low Gap Road to Mendocino City, 6 mi. from Ukiah, June 21–24, 1922, *Abrams 8124* (D, M, P, RM); Potter Valley, May 19, 1925, *Eastwood 12664* (CA); ferry over Eel River, on road to Mt. Sanhedrin, May 25, 1925, *Eastwood 12664a* (CA); hills near Covelo, June 5, 1928, *Eastwood 15187, in part* (UC); Round Valley, June, July, 1906, *Goddard 616, 627* (UC); grassy slope, clay soil, yellow pine belt, be-

tween Laytonville and Willitts, July 10, 1923, *Heller 13800* (D, F, M, NY). LAKE CO.: Binkley Ranch, between Cobb Mt. and Adams Springs, June 27, 1933, *Jussel 270* (CA); between Clear Lake and Lower Lake, May 30, 1926, *Kildale 2033, in part* (D); foot of Mt. Sanhedrin, June, 1917, *Reynolds* (CA). NAPA CO.: Pope Creek Bridge, s. of Walters Springs, May 29, 1933, *Keck 2364* (D). SONOMA CO.: Skaggs Springs, July 4, 1892, *Michener & Bioletti* (NY). COUNTY UNCERTAIN: cultivated at the Botanic Garden of Harvard University, 1873 (G, probable type of *C. luteus* var. *oculatus* Watson).

32. Calochortus luteus Douglas ex Lindley in Bot. Reg. **19**: *t. 1567*. 1833.

Calochortus luteus var. *citrinus* Watson in Proc. Am. Acad. **14**: 265. 1879, as to description, but not as to name-bringing synonym; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 138. 1901.

Calochortus citrinus Hort. in Gard. Chron. Ser. III. **18**: 14. 1895, not Baker, 1875.

Calochortus venustus var. *citrinus* Hort. ex Bonstedt in Pareys Blumengärt. **1**: 273. 1931, not Baker, 1874.

Bulb ovoid, with membranaceous coats; stem erect, rather slender, sometimes branched, bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–4-flowered, subumbellate; flowers erect, campanulate, deep yellow, the petals usually pencilled below with radiating, reddish brown lines, and often with a median blotch of the same color; sepals shorter than the petals, narrowly lanceolate, attenuate, glabrous; petals obovate, cuneate, usually rounded or truncate above, with or without a short apiculation, sparsely invested near the gland with slender hairs; gland not depressed, transversely more or less lunate, densely covered with short, hair-like processes; anthers linear-oblong, obtuse or acute, about as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit narrowly lanceolate, acute, 3-angled, erect; seeds strongly flattened, with hexagonally reticulate coats.

Calochortus luteus is exceedingly variable in size and in the markings on the petals, but relatively constant in color and in the shape of the gland. In the Coast Ranges, from the region of San Francisco Bay to Santa Barbara, it is quite uniformly dwarfed, and the petals are merely pencilled. This is the typi-

cal element of the species. Northward in the Coast Ranges, and in the interior, the plants are larger and usually have a conspicuous blotch on each petal. This form has, for years, passed as the variety *citrinus*, but that name was originally applied to a different entity. The coastal race seems to be cytologically triploid, while that from the interior is diploid. The frequency of morphological intermediates, however, and the incompleteness of our cytological knowledge, does not allow their taxonomic separation at the present time. The diploid race frequently hybridizes with *C. superbus*, but with the exception of these hybrid intermediates, the two species are readily distinguished on color and gland characters.

DISTRIBUTION. California: usually in heavy soils, in the interior from Tehama County southward to Tulare County, and in the Coast Ranges from Mendocino County to Santa Barbara County; also on Santa Cruz Island.

CALIFORNIA. BUTTE CO.: Chico Creek, May, 1896, *Austin 26* (M, UC); near Clear Creek, May 1–15, 1897, *Brown 206* (D, F, M, NY, PA, RM); Little Chico, April, 1897, *Bruce 2119* (P); Chico, April, 1899, *Copeland* (D); near Pentz, 150 m. alt., May 25, 1913, *Heller 10760* (D, G, M, NY, PA); low, treeless, grassy hills, below the *Quercus Douglasii* belt, 8 mi. n. of Oroville, April 24, 1914, *Heller 11322* (CA, D, F, G, M, NY, PA, UC); Berry Canyon, near Clear Creek, May 8, 1902, *Heller & Brown 5494* (D, F, G, M, NY, P, PA, RM); 5 mi. e. of Oroville, on road to Bangor, May 31, 1933, *Keck 2416* (D, P); Durham, May 1, 1932, *Morrison* (CA). YUBA CO.: Smartsville, May 22, 1923, *Crambie* (CA); Los Vergils, May 22, 1921, *Eastwood 10546* (CA). ELDORADO CO.: along road from Tahoe to Placerville, May, 1928, *Rodda* (CA). AMADOR CO.: Jackson Gate, 450 m. alt., May, 1895, *Hansen 589* (D, M); New York Falls, 450 m. alt., June 7, 1896, *Hansen 589* (P); 3½ mi. w. of Buena Vista, T. 5 N., R. 9 E., 120 m. alt., May 6, 1935, *Roseberry 150* (UC). CALAVERAS CO.: Copperopolis, May 18–30, 1895, *Davy 1327* (UC); Reservoir, May 18, 1887, *Smith* (PA); dry fields, near Valley Springs, 150 m. alt., May 21, 1927, *Stanford 313* (P, RM). TUOLUMNE CO.: heavy soil, French Flat, 435 m. alt., May, 1919, *Williamson 116* (CA, Clokey, D, NY, P, RM). MARIPOSA CO.: Hell Hollow, near Bagby, Merced River Canyon, May 11, 1929, *Branson* (CA); Hayward, 5½ mi. e. of La Grange, S. 30, T. 3 S., R. 15 E., 180 m. alt., April 14, 1936, *Carlson 298* (UC); ½ mi. s. of Ward Mt., S. 32, T. 6 S., R. 18 E., 540 m. alt., May 2, 1935, *Schlobohm 82* (UC). MADERA CO.: along Southern Pacific Right-of-Way, 1 mi. s. of Berenda, April 22, 1925, *Bacigalupi 1225* (D, P); Madera, May 9, 1925, *Eastwood 12624* (CA); open plains, heavy soil, 4 mi. n. of Madera, May 8, 1933, *Keck 2280* (D, P); W. Lane's Bridge, May 11, 1902, *Thompson* (D, P). FRESNO CO.: Cascada, 1500 m. alt., June 25, 1917, *Grant 1007, in part* (G). TULARE CO.: near Tulare, April 14, 1934, *Jones* (P); fields along the highway, Lind Cove, April, 1930, *Parks & Parks 0580* (D, F, G, M, NY, P, RM, UC, UCLA). TEHAMA CO.: Red Bluff, April, 1893, *Cannon* (CA); Susanville Road, 5 mi. e. of Red Bluff, May 9, 1930, *Gillespie 9266* (D); 4 mi. s. of Cottonwood, May 21, 1936, *Hoover 1179* (O); Red Bluff, May 27, 1915, *Smith* (CA); Red Bluff, June, 1917, *Wickes* (CA). COLUSA

CO.: near College City, May 20, 1902, *Heller* (M); near College City, Sacramento Valley, 1905, *King* (UC). LAKE CO.: Lower Lake, June 3, 1917, *Bentley* (D); Lower Lake, May 9, 1902, *Bowman* (D); Sulphur Banks, May, 1902, *Bowman 127* (D). SUTTER CO.: Marysville Buttes, May 17, 1903, *Copeland 3187* (G, M, NY, P); western base of Marysville Buttes, April 22, 1926, *Ferris 6386* (D). NAPA CO.: White Sulphur Spring, St. Helena, May 30, 1907, *Chandler 7602* (UC); Calistoga, June 5, 1915, *Eastwood 4629* (CA); grassy opening in chaparral, Gordon Valley, Napa Range, May 30, 1929, *Howell 4258* (CA); grassy banks in chaparral, 20 mi. n. of Napa, June 7, 1934, *Maguire, Maguire & Maguire 15076* (UM); Calistoga, May, 1895, *Merrill* (P); head of Moores Creek, 3–4 mi. e. of Angwin's, Howell Mt., 360 m. alt., June 19, 1899, *Tracy 449* (UC). SACRAMENTO CO.: arid slopes at the edge of the foothills, near Alder Creek, May 21, 1938, *Copeland* (O); dry, sandy, rolling ground, Carmichael, near Sacramento, May 11, 1917, *Ramaley 11228* (UC). SOLANO CO.: near Vacaville, May 2–6, 1891, *Jepson* (D). SAN JOAQUIN CO.: Linden, May, 1896, *Gunnison* (UC); near Stockton, April, 1923, *Steinbeck* (CA). MERCED CO.: Merced Falls, April 23, 1915, *Eastwood 4385* (CA); dry, rocky soil on edge of foothills, San Joaquin Valley, near Merced, May 12, 1923, *Howell 8* (CA). MENDOCINO CO.: Ukiah, June 13, 1913, *Eastwood* (CA); Ukiah, May 4, 14, 1869, *Kellogg & Harford 1001* (G, NY); Hopland Grade, s. of Hopland, 150 m. alt., May 24, 1927, *Kildale 3174* (D). SONOMA CO.: near Healdsburg, April 31, 1918, *Abrams 7067* (D); Kenwood, July, 1893, *Bioletti* (NY); near Santa Rosa, May 8, 1905, *Brandegee* (UC); Skaggs Springs, June 3, 1915, *Hawver* (CA); Windsor, June 23, 1918, *Jepson 7656* (D); mountains w. of Calistoga, May, 1894, *Kraus* (D); grassy, dry hillslopes, near Mark West Springs, June 2, 1929, *Mexia 2389* (UC); El Verano, May 30, 1892, *Michener & Bioletti* (NY); Los Guilicos, May, 1893, *Michener & Bioletti* (F, NY, P, PA, UC). MARIN CO.: Tamalpais, June 18, 1905, *Brandegee* (UC); Tiburon, June 9, 1912, *Eastwood 308* (CA, Clokey, G, NY); Mt. Tamalpais, July 5, 1902, *Jones* (P). ALAMEDA CO.: Oakland Hills, *Bolander 409* (NY); East Oakland Hills, June, 1900, *Carruth* (CA); Mocho Creek (Cedar Mt.), May, 1903, *Elmer 4353* (CA, D, M, P, UO, WS); Sunol, May 5, 1900, *Grant* (D); Oakland Hills, June 6, 1868, *Kellogg & Harford 1002* (M, NY); Pleasanton, May, 1912, *Sanford* (P). SAN MATEO CO.: near Lake Pilarcitos, June 20, 1905, *Brandegee* (UC); dry foothills, May 22, 1932, *Demaree 9159* (M); from Woodside to Crystal Springs Lake, May 18, 1894, *Dudley* (D, P); Crystal Springs, May, 1896, *Eastwood* (UC); Los Trancos Creek, May 25, 1920, *Hichborn 260* (M); fields, near Los Trancos Creek, May 17, 1920, *Kimber & Roush* (P); along San Francisquito Creek, near St. Michaels Church, June 14, 1895, *Lamb* (D); Kings Mt. Road, June, 1907, *Randall 222* (D); open, dry hills, Crystal Springs Lake, June 23, 1933, *Rose 33255* (M, NY, UM); Sand Hill Road, vicinity of Stanford University, June 30, 1917, *Roush* (M); dry ground, Crystal Springs Lake, June 23, 1913, *Suksdorf 317* (G); Woodside, June 9, 1919, *Walther* (CA). SANTA CLARA CO.: Stanford University, May, 1901, *Abrams 1656* (D, M); Stanford University, April, 1900, *Atkinson* (D); hill above Palo Alto Stock Farm, April 24, 1895, *Burnham* (P); near Stock Farm, Stanford University, June 8, 1893, May 14, 1894, *Dudley* (D); Pine Ridge, Mt. Hamilton Range, May 29, 1895, *Dudley 4024* (CA, D, G, UC); road to Madrone Springs, June 5, 1937, *Eastwood & Howell 4526* (CA); Stanford University, May, 1900, *Elmer 2037* (M, NY); Los Gatos, May, 1901, *Elmer 2971* (M); fields near Coyote River, along Cochran Road, 3½ mi. from Madrone Station, May 17, 1918, *Ferris 845* (D); foothills w. of Los Gatos,

May 7, 1904, *Heller 7387* (D, F, G, M, NY, PA, RM, UC); open, grassy places, above Smith Creek, Mt. Hamilton, 900 m. alt., May 31, 1907, *Heller 8630* (D, F, G, M, NY, PA); Raymonds Ranch, Los Gatos, June 18, 1914, *Newell* (CA); San Juan Hills, near San Jose, May 8, 1895, *Patterson* (D); grassy slope, above Smith Creek, 780 m. alt., May 31, 1907, *Pendleton 915* (UC); Stanford University, May 27, 1907, *Randall 221* (D); rolling hills at north end of San Antonio Valley, Mt. Hamilton Range, 690 m. alt., May 18, 1935, *Sharsmith 3087* (WS); dry, grassy slope of Mt. Day Ridge, Mt. Hamilton Range, 960 m. alt., May 21, 1936, *Sharsmith 3697* (O). SANTA CRUZ CO.: Santa Cruz, June 23, 1881, *Jones* (P); Santa Cruz, June 22, 1903, *Thompson* (D, M). SAN BENITO CO.: Lone Tree Road, lower canyon of Arroyo Dos Picachos, May 28, 1938, *Hoover 3491* (O). MONTEREY CO.: Monterey, ex herb. *Abbott* (CA); pine forest, Pacific Grove, July 10, 17, 1905, *Coleman* (D); locality uncertain, but presumably near Monterey, "Nova California," 1833, *Douglas* (G, NY), TYPE COLLECTION; Carmel Trail, Carmel Valley, June 25, 1905, *Dudley* (D); Carmel Bay, June, 1903, *Elmer 4600* (CA, D, M, NY, P, UC, UO); pine woods, Monterey, July 8, 1880, *Engelmann* (M); Carmel Valley, near Carmel, May 22, 1931, *Howell 6496* (CA); Pacific Grove, June 11, 1907, *Patterson & Wiltz* (D); Reservoir, Pacific Grove, June 14, 1907, *Patterson & Wiltz* (D, UC); Highlands Road, Carmel, June 24, 1929, *Rountree* (P). SAN LUIS OBISPO CO.: hills, near Pettitts, May 19, 1928, *Eastwood 15173* (CA); near San Luis Obispo, May, 1879, *Summers* (UC); Los Osos Valley, June 24, 1882, *Summers* (UC); hillsides, 2–3 mi. e. of Templeton, May 9, 1926, *Wiggins 2066* (D). SANTA CRUZ ISLAND: dry bank, interior, June 15, 1930, *Hoffmann* (P); without exact locality, June 6, 1918, *Miller* (CA); without exact locality, June 11, 1930, *Rand 10* (CA).

32x. Calochortus luteus x C. superbus.

The following collections appear to represent hybrid populations between *C. luteus* and *C. superbus*. The variation shown is much greater than in either of the parent species, and very rarely are two specimens alike.

CALIFORNIA. TEHAMA CO.: 3 mi. w. of Paynes Creek, April 22, 1934, *Eastwood & Howell 1876* (CA); Red Bluff, June, 1917, *Wickes* (CA). BUTTE CO.: Colby, July, 1896, *Austin 29* (M); gravelly north slope, *Quercus Douglasii* belt, near Richardson Springs, May 22, 1914, *Heller 11424* (CA, D, F, G, NY, PA, UC); Durham, May 8, 1932, *Morrison* (CA). YUBA CO.: Los Vergils, May 22, 1921, *Eastwood* (CA). ELDORADO CO.: near New York Ravine, 7 mi. above Folsom, May 30, 1907, *Brandegee* (UC). CALAVERAS CO.: Mokelumne Hill, *Blaisdell* (CA). LAKE CO.: 3 mi. e. of Houghs Springs, May 7, 1928, *Abrams 12552* (D); meadow on Pope Valley-Middletown Road, 3 mi. n. w. of county line, June 2, 1933, *Bacigalupi, Ferris & Wiggins 6706* (D, UC); open, gravelly places, yellow pine belt, valley of a tributary of Cache Creek, 5 mi. e. of Houghs Springs, May 10, 1919, *Heller 13145* (CA, D, F, G, M, NY, PA); hillside, between Clear Lake and Lower Lake, 450 m. alt., May 30, 1926, *Kildale 2033, in part* (D); 5 mi. e. of Houghs Mineral Springs, May 7, 1928, *Kildale 4981* (D).

33. Calochortus Leichtlinii J. D. Hooker in Bot. Mag. Ser. III. 26: *t. 5862.* 1870.

Calochortus Nuttallii var. *Leichtlinii* Smiley in Univ. Calif. Publ. Bot. **9**: 139. 1921.

Calochortus Nuttallii Torrey & Gray in Rept. Pac. R. R. Surv. **2** [Bot. Beckwith's Rept. p. 124]. 1855, excl. syn., not Torrey, 1852.

Calochortus Nuttallii var. *subalpinus* Jones, Contrib. West. Bot. No. 12, p. 78. 1908.

Bulb ovoid, with membranaceous coats; stem erect, sometimes very short, usually unbranched, with a large, solitary bulblet in the pouch-like sheath of the lowest cauline leaf; leaves linear, reduced upward; inflorescence 1–5 (usually 2–4)-flowered, subumbellate; flowers erect, campanulate, white or smoke-colored, often tinged with pink or lavender, with a red to nearly black spot on each petal above the gland; sepals usually much shorter than the petals, lanceolate, acute or acuminate, glabrous; petals obovate, cuneate, usually obtuse and rounded above, invested near the gland with a few short hairs; gland slightly depressed, irregular, but more or less triangular-ovate, densely covered with short, hair-like processes which are directed downward; anthers linear-oblong, more or less sagittate at the base, often strongly so, longer than the basally dilated filaments, ovary linear, not winged, tapering to a persistent, trifid stigma; fruit narrowly lanceolate, acute, erect; seeds flattened, with conspicuously inflated, hexagonally netted coats.

Calochortus Leichtlinii is well separated from its allies by reason of its sagittate anthers and inflated seed-coats. In the petal markings, it approaches *C. Nuttallii*, but is distinguished from that species by its lack of a gland-membrane, as well as by the anther character. In color, it is quite variable, but the various color races do not seem to be of taxonomic significance. At high elevations, it is often nearly acaulescent, but under favorable conditions is nearly as tall as any of its allies.

DISTRIBUTION. At middle and high elevations on the mountains about Lake Tahoe, Nevada, and in the Warner Mountains and Sierra Nevada of California, from Modoc County southward to Tulare County.

NEVADA. WASHOE CO.: Peavine Mt., June 22, 1909. *Heller 9755* (D, G, NY, PA); Third Creek, near Mt. Rose, 2550–3150 m. alt., Aug. 3, 1938, *Howell 14113* (CA).

ORMSBY CO.: Kings Canyon, 1700–2000 m. alt., June 21, 1902, *Baker 1108* (G, M, NY, P). MINERAL CO.: among aspens, Sweetwater Mts., near Sweetwater, 2100 m. alt., July 1, 1919, *Tidestrom 10180* (NY).

CALIFORNIA. MODOC CO.: Mill Creek Meadows, west slope of Warner Mts., July 31, 1932, *Applegate 7958* (D); dry, open slope, Warren Peak, Warner Mts., Aug. 1, 1932, *Applegate 8004* (D); arid summit of Warner Mts., near and s. of Warren Peak, 2400 m. alt., Aug. 1, 1932, *Applegate 8042* (D); North Fork of Barber Creek, Warner Mts., 1800 m. alt., June 13, 1934, *Howell 12101* (CA); on sandy ridge, head of North Fork of Parker Creek, Warner Mts., 2250 m. alt., July 13, 1910, *Taylor & Bryant* (UC). LASSEN CO.: Pine Creek, July 12, 1894, *Baker & Nutting* (UC); Susanville, July 2, 1892, *Brandegee* (D); Perkin's Ranch, Diamond Mt., Susanville, 1800–2100 m. alt., June 28, 1897, *Jones* (M, P). SHASTA CO.: Lassen Peak, 1800 m. alt., July 8, 1897, *Jones* (D, P). PLUMAS CO.: Lights Canyon, 1871, *Ames* (NY); Quincy, May 28, 1920, *Clemens* (CA); Forest Lodge, Greenville, U. S. Forest Reserve, June, 1927, *Eastwood 14569* (CA); in woods, on road from Chilcott, U. S. Forest Reserve, June 27, 1927, *Eastwood 14882* (CA); Jameson Creek, 1890 m. alt., July 7, 1912, *Hall 9311* (UC); in gravelly soil, Feather River Region, July 25, 1920, *Head* (CA); Campbells Hot Springs, Feather River Region, June 22, 1921, *Head* (CA); Lake Center Camp, Feather River Region, July 15, 1921, *Head* (CA); ridge e. of Red Clover Valley, July 4, 1907, *Heller & Kennedy 8719* (CA, D, F, G, M, NY, P, PA); Drakesbad, Mt. Lassen National Forest, June 17–30, 1928, *Hollis* (UCLA); 5 mi. w. of Prattville, 1350 m. alt., July 6, 1897, *Jones* (P); Greenville, July, 1920, *Kelley* (CA); 3.25 mi. s. e. of Beckwith Butte, S. 27, T. 22 N., R. 14 E., 1560 m. alt., June 4, 1935, *Sawyer 70* (UC); southwest slopes and ridge crest, Red Rock, n. of Engelmine, 2120–2180 m. alt., July 9, 1937, *Stebbins & Jenkins 2243* (UC). TEHAMA CO.: Mill Creek Canyon, near Morgan, 1500 m. alt., July 1, 2, 1903, *Hall & Babcock 4355* (UC). BUTTE CO.: on bare or open stony outcrops and ridges, above Jonesville, 2000 m. alt., July 17, 1929, *Copeland 352* (CA, D, F, G, M, NY, P, RM, UC, UCLA, UO); on open, gravelly slopes about rocks, in granite, yellow pine belt, Little Summit, Sierra Nevada, 1350 m. alt., June 10, 1915, *Heller 11953* (CA, D, F, G, M, NY). SIERRA CO.: Packer Lake, 1950 m. alt., July 3, 1926, *Barker 32* (D); Salmon Lake, July, 1918, *Sutliffe* (CA). NEVADA CO.: southeastern approaches to Castle Peak, July 31, 1903, *Heller 7062* (D, G, M, NY, P, PA, RM, UC); Soda Springs, 2100 m. alt., July 21, 1881, *Jones 2418* (P); Donner Lake, near Truckee, July 12, 1882, *Sonne* (UC); sandy soil, Truckee, July, 1890, *Sonne 317* (M). PLACER CO.: Emigrant Gap, June 27, 30, 1882, *Jones* (P); Summit, Sierra Nevada, 2400 m. alt., July 26, 1900, *Jones* (P, type of *C. Nuttallii* var. *subalpinus* M. E. Jones); High Mt., near Donner Pass, Sierra Nevada, 1865, *Torrey 519(a)* (G, NY). ELDORADO CO.: dry, gravelly soil, Tallac, Lake Tahoe, 1950 m. alt., June, 1918, *Abrams 7326* (D); Fallen Leaf Lake, near Lake Tahoe, July 1, 1904, *Baker* (UC); Fallen Leaf Lake, Lake Tahoe Region, June 28, 1920, *Campbell* (RM); Glen Alpine Springs Hotel, June 28, 1900, *Dudley* (D); Deer Park, Lake Tahoe Region, 1909, *Eastwood 252* (CA); Camp Agassiz, Glen Alpine Region, July 23, 1906, *Eastwood 994* (CA); Upper Echo Lake, 2400 m. alt., July 19, 1928, *Essig* (UC); 1 mi. below Phillips, July, 1920, ex herb. *Evans* (UC); Tallac, vicinity of Lake Tahoe, 1800–2400 m. alt., Aug. 1, 1906, *Grant* (D); Aspengrove, Lake Tahoe Region, Aug., 1911, *Hawver* (CA); Armstrong's, Emerald Bay, Lake Tahoe, 1860 m. alt., June 30, 1925, *Howell 1264* (CA); between Fallen Leaf Camp and Lake Tahoe, July 2, 1925,

Howell 1347 (CA); near Fallen Leaf Lake, July 12, 1909, *Lathrop* (D); Grass Lake Trail, Glen Alpine, 2170 m. alt., July 23, 1907, *Pendleton & Reed 1003* (UC); Lily Lake to Glen Alpine, 1995 m. alt., July 25, 1907, *Pendleton & Reed 1250* (UC); Lake Tahoe, June, 1917, *Rock* (CA); Glen Alpine, vicinity of Lake Tahoe, 1867–2700 m. alt., July 6–21, 1901, *Setchell & Dobie* (UC); slope back of mill, Tallac Sawmill, Tahoe, 1920 m. alt., July 17, 1913, *Smiley 141* (G); near Suzy Lake, Tahoe, 2280 m. alt., July 18, 1913, *Smiley 167* (G). ALPINE CO.: Blue Lakes, 2550 m. alt., Aug., 1892, *Hansen 1252* (D, M); 1½ mi. n. e. of Lake Alpine, S. 35, T. 8 N., R. 18 E., 2430 m. alt., July 20, 1935, *Howden 33* (UC); open summit of ridge, about 2 mi. n. of the lake, Lake Alpine Region, 2520 m. alt., July 25, 1935, *Peirson 11588* (UC); Hope Valley, Summer, 1923, *Wright* (CA). AMADOR CO.: Panther Creek, 1500 m. alt., May, 1895, *Hansen 1070* (D, M); Panther Creek, 1440 m. alt., June 13, 1895, *Hansen 1070* (P). CALAVERAS CO.: Salt Spring Reservoir, June, 1923, *Steinbeck* (CA). MONO CO.: among rocks, in dry situations, Timberline Station, south-facing wooded slope above cabin, Slate Creek Basin, e. of Mt. Conness, Aug. 24, 1933, *Clausen 815* (NY); gravelly, deep soil, south slope, north side of Slate Creek Valley, Slate Creek Basin, e. of Mt. Conness, 3050–3200 m. alt., Aug. 22, 1932, *Coulter 6* (D, NY, P, RM, UCLA, UM); Leevining, *Ehlers 828* (UC); among bushes of *Artemisia tridentata*, east-facing slope, 2 mi. n. of Mono Lake P. O., 2028 m. alt., June 17, 1937, *Grinnell & Grinnell 1064a, 1064b* (UC); Tioga Road, near Mono Lake, Summer, 1923, *Wright* (CA). TUOLUMNE CO.: along Tioga Road, Aug. 14, 1907, *Eastwood 321* (CA); Camp Baxter, North Fork of Stanislaus River, 1650 m. alt., June 27, 1930, *Jussel* (CA); Camp Baxter, 20 mi. from Dorrington, 1680 m. alt., June 28, 1930, *Jussel* (UM); Mather, Sierra Nevada, 1400 m. alt., June 6, 1931, *Keck 1217* (CA); open, lava-rocky hills, s. e. of Grizzly Meadows, Stanislaus National Forest, June 3, 1934, *Quick 1278* (CA); Pikes Peak, 2175 m. alt., June 20, 1937, *Quick 1823* (CA); Upper Cow Creek, 2130 m. alt., June 29, 1937, *Quick 1858* (CA); Tiltill Trail, n. of Tiltill Valley, 2100 m. alt., July 30, 1938, *Sharsmith 3738* (O, WS); sandy soil among granite rocks, Camp Baxter, 1650–1710 m. alt., June 30, 1929, *Stanford 1076* (D); Leland Meadows, 4 mi. above Strawberry, July 4, 1925, *Steinbeck* (CA); Sonora, June 7, 1931, *Van Dyke* (CA); open hillside, ½ mi. above Lyon's Dam, along road connecting with Sonora Pass Highway, June 15, 1934, *Wiggins 6865* (D); open ridge, 3½ mi. above Pine Crest, on road to Belle Meadow, July 8, 1934, *Wiggins 6902* (D). MARIPOSA CO.: Yosemite Valley, Yosemite National Park, 1200–1350 m. alt., June 20, 1911, *Abrams 4432* (D, G, NY, P, UC); Yosemite Valley, 1200 m. alt., July, 1926, *Beller* (UCLA); between Aspen Valley and Lake Tenaya, Yosemite Park, July 16, 1935, *Epling & Robison* (UCLA); Little Yosemite Valley, Yosemite National Park, 1860 m. alt., July 7, 1911, *Hall 9058* (UC); sandy, rocky soil, along river, Wawona Valley, 1200 m. alt., June 25, 1923, *Howell 91* (CA); Lightning Trail to the Big Trees, Wawona Valley, 1260 m. alt., June 22, 1924, *Howell 435* (CA); creek above Inspiration Point, Yosemite Valley, July 5, 1913, *Kennedy 3027* (CA); Yosemite Valley, June, 1906, *Saunders* (CA); sunny slope, Snow Creek Trail, Yosemite National Park, June 25, 1935, *Schreiber 1705* (UC); sunny, sandy slope, Maclure Fork of the Merced River, Yosemite National Park, July 29, 1935, *Schreiber 1895* (D, UC). MADERA CO.: rocks, granite, Shuteye Mt., Sierra National Forest, 1950 m. alt., July 26, 1907, *Murdoch 2560* (F, NY). FRESNO CO.: Rowell Meadow, Upper Kings River, Aug. 23, 1904, *Dudley* (D); Collins Meadow, 2250 m. alt., July, 1900, *Hall & Chandler 453* (D, M, NY, PA, UC);

Huntington Lake, 2100 m. alt., July 26, 1917, *Grant 1142* (D). TULARE CO.: Kern-Kaweah Canyon, 2790 m. alt., July 29, 1927, *Bacigalupi 1770* (D, P); dry ground, Kern River, vicinity of Lloyd Mt., 1800 m. alt., July 21, 1895, *Dudley 830* (D); trail from Halsted Meadow to Clover Creek, region of Mt. Silliman, 2700–3000 m. alt., July 27, 1896, *Dudley 1455* (D); Balanced Rock Trail, General Grant National Park, July 4, 1927, *Jussel* (CA); Marble Fork of Kaweah River, near Lodgepole Camp, Sequoia National Park, July 3, 1931, *Larson* (CA).

Subsection 6. MACROCARPI.[36]

Inflorescences subumbellate; sepals usually greatly exceeding the petals, narrowly lanceolate, attenuate; petals oblanceolate, cuneate, acuminate, sparingly invested near the gland with slender hairs; glands slightly depressed, triangular-oblong, more or less sagittate, surrounded with a broad, fringed membrane, and densely covered with slender, simple or distally branched processes; anthers linear-lanceolate to linear, obtuse; fruits linear-lanceolate, acuminate, 3-angled; seeds strongly flattened, with conspicuously inflated, hexagonally reticulate coats.

The single species referred to the subsection MACROCARPI is easily recognized by its very long sepals and linear or nearly linear anthers. It has a Columbian Plateau distribution, reaching British Columbia on the north, Montana and Idaho on the east, and Nevada and California on the south. On the west it is limited by the Cascade Range (Map 6). Its chromosome base number is seven.

34. Calochortus macrocarpus Douglas in Trans. Hort. Soc. Lond. **7**: 276, *pl. 8.* 1828.

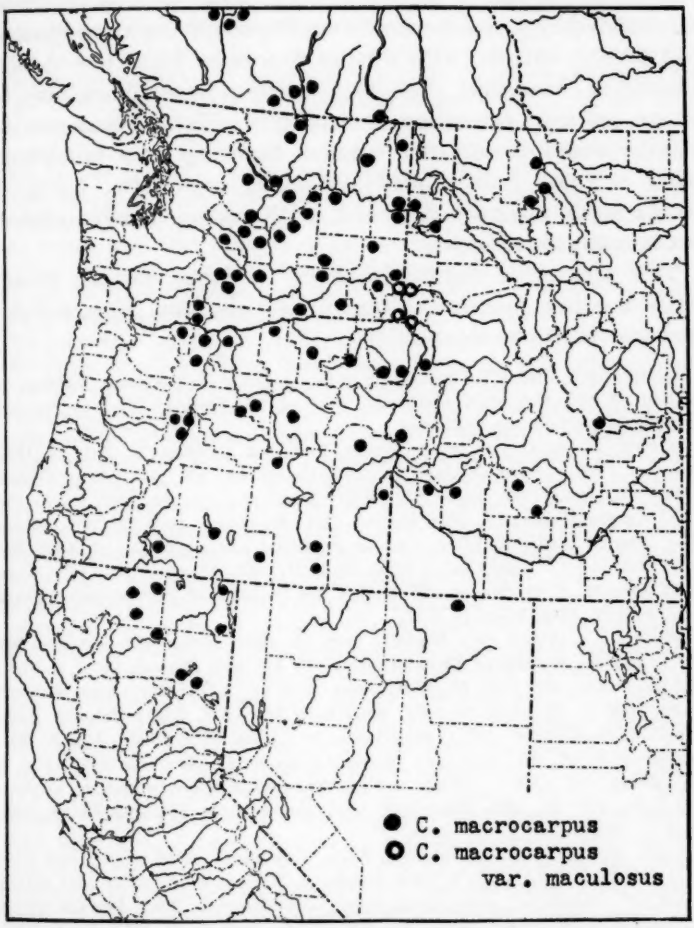
Calochortus acuminatus Rydberg in Bull. Torr. Bot. Club **24**: 189, *pl. 301.* 1897.

Calochortus cyaneus A. Nelson in Bot. Gaz. **53**: 219. 1912.

Calochortus macrocarpus var. *cyaneus* Macbride in Contrib. Gray Herb. N. S. No. 56, p. 14. 1918.

[36] MACROCARPI subsect. nov., inflorescentiis subumbellatis; sepalis petalis plerumque multo longioribus anguste lanceolatis attenuatis; petalis oblanceolatis cuneatis acuminatis, prope glandulam pilis gracilibus parce praeditis; glandulis subdepressis triangulari-oblongis plus minusve sagittatis, membrana lata fimbriata circumdatis, processis gracilibus simplicibus aut apice ramosis dense vestitis; antheris lineari-lanceolatis vel linearibus obtusis; capsulis lineari-lanceolatis acuminatis triangulatis; seminibus valde complanatis, testis insigniter inflatis hexagono-reticulatis.

Bulb ovoid, with membranaceous coats; stem stout, erect, usually unbranched, often bulbiferous; leaves linear, reduced upward, becoming strongly involute and curled at the tip; in-



Map 6. Distribution of the species and variety of the subsection MACROCARPI.

florescence 1–3-flowered, subumbellate; flowers erect, purple, each petal with a median, longitudinal, green stripe, and sometimes with a transverse, dark purple band above the gland;

sepals usually exceeding the petals, narrowly lanceolate, long-attenuate, glabrous; petals oblanceolate, acuminate, moderately bearded just above the gland with slender hairs; gland slightly depressed, triangular-oblong, more or less sagittate, surrounded by a broad, usually continuous, fringed membrane, and densely covered with slender processes which are usually somewhat branched distally; anthers linear-lanceolate to linear, obtuse, exceeding the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-lanceolate, acuminate, 3-angled, erect; seeds strongly flattened, with conspicuously inflated, hexagonally netted coats.

This species is distinguished by its large, purple, green-striped petals, narrow, attenuate sepals, and long, slender anthers. It has no close allies.

DISTRIBUTION. Dry hills, usually in loose, volcanic soil, western Montana to southern British Columbia, southward, east of the Cascade Mts., to northern Nevada and northeastern California.

BRITISH COLUMBIA. Dry, open country, Penticton, Cariboo Co., July 24, 1902, *Anderson* (WS); Ashcroft, June 28, 1907, *Cowles 222* (F, M); plains, Clinton, Cariboo Co., June, 1897, *Foster 15a* (WS); Kamloops, June 30, 1887, *Fowler* (M, NY); Kamloops, June 17, 1889, *Macoun* (M); Kamloops, June 22, 1889, *Macoun* (F); Waneta, Columbia River, near International Boundary, Aug. 1, 1902, *Macoun 70200* (G, P); Similkameen River, June 14, 1905, *Macoun 70211* (F); Kamloops, June 28, 1916, *Sanson 163* (NY); dry foothills of the mountains, Skaha Lake, June 25, 1934, *Went 18* (UC).

MONTANA. FLATHEAD CO.: Bigfork, July 23, 1908, *Butler 918, 919, 920, 921* (NY); Bigfork, vicinity of Flathead Lake, July 15, 1908, *Clemens* (D, F, G, PA); Bigfork, 900 m. alt., July 23, 1908, *Jones 9216* (P, UM); dry plains, Flathead Valley, 1000 m. alt., July 25, 1901, *MacDougal 765* (NY, UM); Columbia Falls, July 31, 1892, *Williams* (NY). BEAVERHEAD CO.: Lima, 2700 m. alt., Aug. 5, 1895, *Rydberg 2600* (M, NY, type of *C. acuminatus* Rydberg); dry hills, Lima, Aug. 5, 1895, *Shear 3127* (NY). COUNTY NOT DETERMINED: hillsides, west shore of Flathead Lake, July 21, 1883, *Canby 327* (G); plains of the Flathead Valley, July, *Elrod 18* (RM).

IDAHO. KOOTENAI CO.: about Post Falls, July 14–17, 1892, *Heller 660* (PA, UC); Wiesners Peak, July 8, 1892, *Sandberg, MacDougal & Heller 1043* (D, F, G, NY, P). IDAHO CO.: rocky north slope, on Government Trail, between Squaw and Granite creeks, Seven Devils Mts., 510 m. alt., June 13–30, 1937, *Packard 247* (WS). WASHINGTON CO.: Weiser, 660 m. alt., July 5, 1899, *Jones* (P). BLAINE CO.: Ketchum, *Brodhead* (P); sagebrush slopes, Tikura, 1350 m. alt., July 22, 1911, *Macbride 1286* (RM); sagebrush slopes, along Hyndman Creek, Sawtooth Range, 1800 m. alt., July 31, 1936, *Thompson 13646* (M). ELMORE CO.: stony slope, lava rock among sagebrush, Rattlesnake Creek, 1200 m. alt., June 23, 1916, *Macbride &*

Payson 2845 (CA, D, G, M, NY, P, RM, UC). ADA CO.: dry lava hills, Boise, 864 m. alt., June 24, 1911, *Clark 68* (D, F, G, M, RM, UC); dry slopes, Boise, 864 m. alt., June 18, 1910, *Macbride 268* (G, M, RM, type of *C. cyaneus* Nelson). COUNTY NOT DETERMINED: Curlew Gulch, July, 1892, *Mulford* (G, M, NY).

WASHINGTON. PEND OREILLE CO.: Box Canyon, Pend Oreille River, Aug. 3, 1902, *Kreager 391* (Clokey, G, NY, WS). STEVENS CO.: dry, open bunch-grass slope, First Thought Mt., Aug. 2, 1927, *Lockhart* (WS). SPOKANE CO.: rocky, open hillsides, near Spokane, July 13, 1930, *Palmer 37846* (G); Spokane, July 18, 1894, *Piper* (WS); Spokane, 1892, *Tucker* (G); Trent, July 21, 1913, *Turesson* (RM). LINCOLN CO.: dry soil, Congdons Ferry and vicinity, June 22, 1902, *Griffiths & Cotton 415* (NY, WS); dry soil, 15 mi. n. of Wilbur, near Columbia River, July 7, 1923, *Spiegelberg* (WS). WHITMAN CO.: Wawawai, June, 1898, *Elmer* (M); e. of Dusty, June 20, 1934, *Otis 1945* (WS); grassy hillside, Rock Lake, July 21, 1927, *Wittman 95* (WS). ADAMS CO.: Hatton, June 27, 1906, *Cullen* (WS). FRANKLIN CO.: Connell, May, 1902, *Elmer 44* (NY). GARFIELD CO.: Ilia, June 25, 1892, *Lake & Hull* (WS); WALLA WALLA CO.: dry south slopes, Waitsburg, June 12, 1897, *Horner 463* (G, WS). OKANOGAN CO.: Oroville, June 26, 1911, *Jones* (P); Loomis, July 1, 1911, *Jones* (P). DOUGLAS CO.: near Egbert Spring, 390 m. alt., July 7, 1893, *Sandberg & Leiberg 409* (G, NY, UC, UO, WS). CHELAN CO.: Chelan, July 5, 1911, *Jones* (P); Lake Chelan, Cascade Mts., 327 m. alt., July 1–Sept. 15, 1915, *Kammerer 108* (M, NY); dry southern exposure, Old Darby Place, North Fork of Twentyfive Mile Creek, south side of Lake Chelan, 420 m. alt., June 29, 1936, *Kelly 9* (WS); dry, open plains near Chelan, June 25, 1931, *Thompson 6906* (D, G, M); dry sagebrush slopes, n. of Wenatchee, June 23, 1932, *Thompson 8529* (D, M); Wenatchee Flat, July 7, 1900, *Whited 1269* (WS). GRANT CO.: sage lands, Coulee City, June 25, 1923, *St. John 7645* (WS); Alkali Lake, 600–900 m. alt., July, 1892, *Sandberg & Leiberg* (WS); sandy sagebrush plains, near Quincy, June 15, 1931, *Thompson 6773* (D, G, M, PA); sandy sagebrush plains, in Grand Coulee, near Soap Lake, June 15, 1935, *Thompson 11625* (D, NY, P); dry soil, Steamboat Rock, Grand Coulee, July 10, 1902, *MacKay 21* (G, M, NY, PA, WS). KITTITAS CO.: dry, stony soil, northeast Kittitas Valley, July 10, 1903, *Cotton 1339* (PA, RM, WS); sandy soil, among sagebrush, Ellensburg, June, 1897, *Elmer 393* (M, NY, RM, WS); Ellensburg, July 9, 1897, *Piper* (WS); mouth of Rye Grass Coulee, Ginkgo Petrified Forest Park, May 30, 1936, *Smith 726* (WS); up Natches River, above Ellensburg, 1889, *Vasey* (WS). YAKIMA CO.: Yakima Region, June, 1882, *Brandegee* (M); sand plains, n. of Rattlesnake Mts., May 31, 1901, *Cotton 393, in part* (WS); North Fork of Cowichie Creek, July 21, 1901, *Cotton 462* (WS); Fort Simcoe, S. 14, T. 10 N., R. 15 E., 360 m. alt., July 22, 1932, *Heidenreich 195* (WS); Simcoe Hills, July, 1860, *Lyall* (G). BENTON CO.: Horseheaven Hills, 15 mi. s. w. of Kennewick, June 21, 1927, *St. John 8638* (WS). KLICKITAT CO.: Falcon Valley, Aug., 1882, *Howell* (PA); dry, exposed slopes, about 2 mi. e. of Bingen, June 18, 1938, *Meyer 1500* (WS); Trout Lake, Aug. 2, 1911, *Streator* (UCLA); White Salmon, 1879, *Suksdorf* (G); low, dry grounds and hillsides, "W. Klickitat Co.," Aug., 1882, *Suksdorf* (F, NY, PA, UC). COUNTY NOT DETERMINED: near the Great Falls on the Columbia and on undulating grounds of the interior at the junction of Lewis and Clarks River [with the Columbia], *Douglas*, photographs of the TYPE in the Hooker Herbarium at Kew (G, NY, P, PA, WS).

OREGON. WALLOWA CO.: brushy hillside, coniferous woods, southwest end of Wallowa Lake, Wallowa Mts., 1320 m. alt., Aug. 1, 1935, *Constance & Jacobs 1316*

(M, UC, WS); dry soil, Joseph, June 16, 1891, *Drake & Dickson* (F); brushy slopes and coniferous woods, along Adams Creek, 4 mi. s. w. of Wallowa Lake, Aug. 9, 1938, *Ownbey & Ownbey 1850* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UM, UO, WS); dry slope, Imnaha Canyon, 22 mi. above Imnaha, July 13, 1933, *Peck 17656* (WU); dry, grassy slope, Wallowa Lake, July 8, 1934, *Peck 18425* (D, NY, WU). UNION CO.: mountainside above La Grande, July 29, 1910, *Peck 1374* (WU). MALHEUR CO.: loose soil, high above Sucker Creek, between Adrian and Rockville, June 30, 1936, *Andrews 740* (UO); Brogan, 1910, *Cooper* (WU); along irrigation ditch, Brogan, June 24, 1910, *Peck 1373* (WU); dry bank, Sucker Creek Canyon, June 21, 1928, *Peck 16087* (WU). UMATILLA CO.: open, dry, grassy hills, Pilot Rock, Blue Mts., June 16, 1910, *Cusick 3433* (UO, WS). MORROW CO.: among sagebrush, near Boardman, June 14, 1928, *Thompson 4777* (D, M). GRANT CO.: dry, grassy hills, above the John Day River, John Day, July 1, 1919, *Ferris & Duthie 668* (D, RM); sagebrush hills, Middle and Upper John Day, s. of the canyon, June 20, 1925, *Henderson 5393* (CA, D, G, M). HARNEY CO.: sagebrush slope above Three Mile Camp, Catlow Valley, July 6, 1937, *Drews* (UO); dry sage plains or fans, Alvord Ranch, east base of Steens Mts., July 1, 1927, *Henderson 8829* (CA, UO); Alvord Ranch, July 5, 1930, *Jones 25182* (M, P); dry ground, upper Emigrant Creek, July 31, 1912, *Peck 1375* (WU); dry slope, lower Willow Creek Canyon, June 23, 1936, *Peck 18983* (WU). SHERMAN CO.: Rock Creek Canyon, near Moro, June, 1921, *Lawrence 2929* (D); Moro, May, 1894, *Morrison* (NY). WASCO CO.: ravine up Mill Creek, 4 mi. from The Dalles, July 2, 1927, *Thompson 2838* (D); dry hillside, near Tygh, June 24, 1928, *Thompson 4955* (D, G, M, P, PA); dry, rocky ground, Siwash Flats, near Mosier, July 6, 1929, *Thompson 5151* (PA). HOOD RIVER CO.: Hood River, July, 1888, *Drake & Dickson* (F); near Columbia River, Hood River, July, 1922, *Epling 5725* (UCLA); very dry ground, open oak woods or prairies, Hood River Valley, Aug. 10, 1880, *Henderson* (UO); dry ground under oaks, or prairies, Hood River Valley, July 6, 1889, *Henderson* (UO); dry prairies and pine lands, Hood River Valley, July 16, 1896, *Henderson* (RM); dry pine woods and prairies, July 10, 1924, *Henderson 806* (G, M); near Hood River, July 27, 28, 1886, *Howell* (NY, PA). WHEELER CO.: open pine woods, headwaters of Marks Creek, Ochoco National Forest, July 29, 1938, *Ownbey & Ownbey 1801* (G, Kew, M, O, UC); dry slope, Mitchell, July 8, 1921, *Peck 10106* (WU); moist slope, 10 mi. e. of Mitchell, July 20, 1934, *Peck 18632* (WU). DESCHUTES CO.: dry ground, Sisters, July 22, 1914, *Peck 3202* (WU); on the desert, Redmond, July 21, 1912, *Whited A86* (D, G, M, NY); dry desert, Forked Horn Butte, vicinity of Laidlaw, July 22, 1907, *Whited 3080a* (UO). LAKE CO.: in sagebrush, Rock Creek, north slope of Hart Mt., July 16, 1932, *Applegate (?) 7761* (D); dry hillsides, Paisley, July 9, 1928, *Constance (Henderson 9962)* (PA, UO, WS). KLAMATH CO.: base of hills below McCormack Ranch, Klamath Lake, July 15, 1925, *Applegate 4413* (D, UC); dry, rocky hillsides, Algoma, a few mi. n. of Klamath Falls, July 10, 1930, *Henderson 12880* (UO).

NEVADA. ELKO CO.: dry lava rock slopes, Rowland, 1350 m. alt., July 31, 1912, *Nelson & Macbride 2149* (G, RM).

CALIFORNIA. MODOC CO.: sagebrush plains, Surprise Valley, 5 mi. s. of Fort Bidwell, July 9, 1932, *Applegate 7621* (D); yellow pine woods and sagebrush, near and above Jess Valley, South Fork of Pit River Region, Warner Mts., Aug. 4, 1932, *Applegate 8149* (D); Davis Creek, Aug., 189–, *Austin 489* (D, P); sandy ground in the sagebrush, 15 mi. n. of Alturas, Warner Mts., July 18, 1930, *Benson*

2233 (M, NY); Goose Lake Valley, Aug., 1899, *Bruce* (D); near Fort Bidwell, Summer, 1930, *Kelly 8* (CA); Camp Bidwell, 1879, *Matthews* (G). SISKIYOU CO.: Soda Springs, Little Shasta River, July 6, 1876, *Greene 913* (G); lava slopes, Lava Beds National Monument, July 8, 1936, *Thompson 13153* (NY, PA); Sheep Rock, Mt. Shasta, July, 1902, *Wilson* (UC). LASSEN CO.: Eagle Lake, 1500 m. alt., July 21, 1894, *Baker* (UC); Susanville, July 1, 1892, ex herb. *Brandegee* (UC); Perkin's Ranch, Susanville, 1500 m. alt., July 1, 1897, *Jones* (G, M, P). SHASTA CO.: open, rocky slopes of Saddle Mt., w. of Fall River Mills, T. 37 N., R. 4 E., 1320–1470 m. alt., July 16, 1937, *Stebbins & Jenkins 2391* (D).

34a. Calochortus macrocarpus var. **maculosus** (Nelson & Macbride) Nelson & Macbride ex Macbride in Contrib. Gray Herb. N. S. No. 56, p. 14. 1918.

Calochortus maculosus Nelson & Macbride in Bot. Gaz. **56**: 471. 1913.

Petals white or nearly so, with a conspicuous, reddish purple crescent above the gland; otherwise as in the species.

This is probably not more than a well-marked color form, but apparently locally constant, and easily distinguished.

DISTRIBUTION. Dry hills, Nez Perce County, Idaho, and adjacent southeastern Washington.

IDAHO. NEZ PERCE CO.: near Lewiston, June 24, 1902, *Beattie* (WS); mouth of Salmon River, June 27, 1925, *Eastwood 13320* (CA); Lewiston Grade, June 22, 1925, *Eastwood 13413* (CA, WS); in rather loose, disintegrated or volcanic soil, near Lewiston, June 17, 1894, *Henderson 2727* (G, RM TYPE).

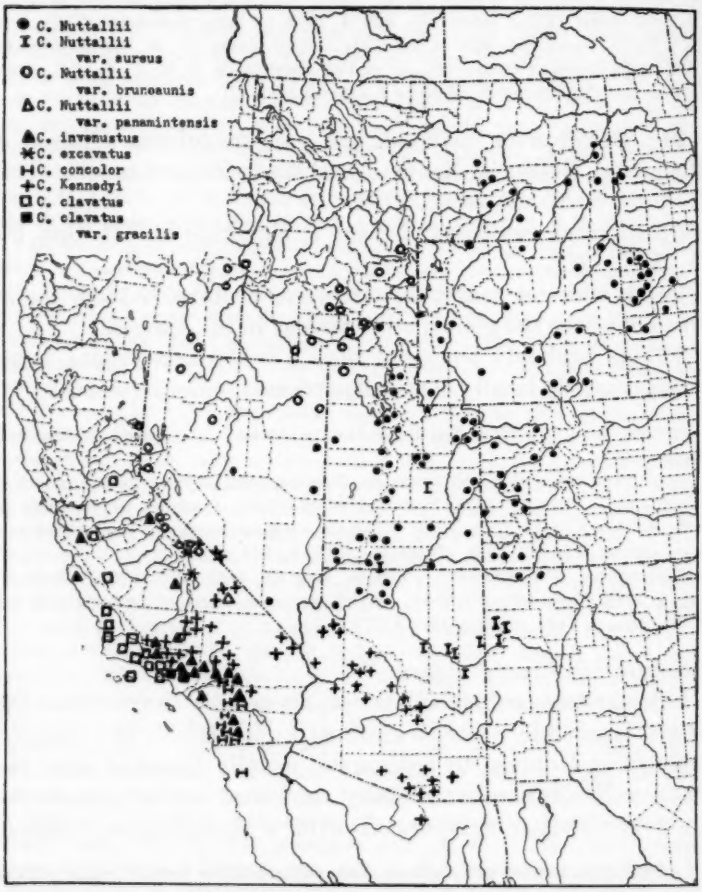
WASHINGTON. WHITMAN CO.: Pullman, July 31, 1892, *Hull* (WS); Pullman, Aug. 4, 1893, *Piper 1681* (G, WS). ASOTIN CO.: near mouth of Joseph Creek, 360 m. alt., June 1, 1897, *Sheldon 8221* (NY).

Subsection 7. NUTTALLIANI.[37]

Inflorescences subumbellate; sepals usually shorter than the petals, lanceolate, acute to acuminate; petals obovate, cuneate, rounded and obtuse to acuminate, usually invested near the gland with filiform or distally thickened hairs; glands depressed, circular, surrounded with a conspicuous, fringed

[37] NUTTALLIANI subsect. nov., inflorescentiis subumbellatis; sepalis petalis plerumque brevioribus lanceolatis acutis vel acuminatis; petalis obovatis cuneatis rotundo-obtusis vel acuminatis, prope glandulam pilis filiformibus aut apice crassatis plerumque praeditis; glandulis depressis circularibus, membrana conspicua fimbriata circumdatis, processis simplicibus aut apice ramosis dense vestitis; antheris anguste oblongis obtusis aut acutis; capsulis lineari-lanceolatis acutis vel acuminatis triangulatis; seminibus valde complanatis, testis insigniter inflatis hexagono-reticulatis.

membrane, and densely covered with simple or distally branched processes; anthers narrowly oblong, obtuse or acute; fruits linear-lanceolate, acute to acuminate, 3-angled; seeds



Map 7. Distribution of the species and varieties of the subsection NUTTALLIANI.

strongly flattened, with conspicuously inflated, hexagonally reticulate coats.

The NUTTALLIANI are distinguished by their circular, de-

pressed glands which are surrounded by a usually broad membrane. The species, for the most part, are closely related and very difficult of delimitation. The chromosome base number, in all known instances, is eight. A single variety is known to be tetraploid. Although most of the species are confined to California and adjacent states, one, *C. Nuttallii*, crosses the deserts of the Southwest, and reaches the northern Great Plains (Map 7).

35. Calochortus Nuttallii Torrey in Stansbury, Exped. Utah, p. 397. 1852.

Calochortus luteus Nuttall in Journ. Acad. Philad. **7**: 53. 1834, not Douglas, 1833.

Fritillaria alba Nuttall, Gen. N. Am. Pl. **1**: 222. 1818, probably in part.[38]

Amblirion album Sweet, Hort. Brit., ed. 2, p. 538. 1830.

Calochortus albus Hort. in Notizblatt Bot. Gart. Mus. Berl. **2**: 318. 1899, not Douglas, 1834.

Calochortus Watsoni Jones, Contrib. West. Bot. No. 14, p. 26. 1912.

Calochortus rhodothecus Clokey in Bull. So. Calif. Acad. **37**: 1. 1938.

Bulb ovoid, with membranaceous coats; stem erect, usually unbranched, often bulbiferous near the base; leaves linear, reduced upward, becoming involute; inflorescence 1–4-flowered, subumbellate, the bracts congested, unequal; flowers erect, campanulate, white, tinged with lilac, or occasionally magenta, the petals yellow at the base and marked with a reddish brown or purple band or spot above the gland, sepals similarly marked; sepals usually shorter than the petals, lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, usually short-acuminate, sparsely invested near the gland with slender hairs; gland circular, depressed, surrounded with a conspicuous, fringed membrane, and densely covered with short, simple

[38] Nuttall apparently confused the species now known as *Calochortus Nuttallii* and *Fritillaria atropurpurea* in his concept of *F. alba*. The type has not been located, and is probably no longer extant. For the most part, the description is of a *Fritillaria*, and the final disposition of the name must await a monographic treatment of that genus.

or distally branched processes; anthers oblong, obtuse, yellowish or pinkish, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-lanceolate, acuminate, 3-angled, erect; seeds strongly flattened, with loose-fitting, hexagonally reticulate coats.

As here defined *Calochortus Nuttallii* is a quite constant and easily recognized entity. It is the most widespread species in the genus and not without some minor variants, but these do not appear to be of taxonomic significance. It is not always easily distinguished from its variety *bruneaunis*, and this, in turn, connects it with *C. invenustus* and *C. excavatus*. On morphological characters alone, the inclusion of these various elements under a single species might be justified, but such a treatment would obscure the fact that they are recognizably distinct natural entities, each with a characteristic geographical range.

DISTRIBUTION. Dry soil, from the northern Great Plains of western North and South Dakota and eastern Montana, southwestward across northwestern Nebraska, Wyoming, southeastern Idaho, and Utah, to southern Nevada and northwestern Arizona; southward through western Colorado to northwestern New Mexico; apparently separated from its variety *bruneaunis* on the northwest by the Snake River and Salt Lake deserts.

NORTH DAKOTA. BILLINGS CO.: Bad Lands, Little Missouri, June 30, 1883, *Canby 326* (G); bluff sides in red soil, Bad Lands, Marmarth, June 10, 1914, *Moyer 523* (NY).

SOUTH DAKOTA. MEADE CO.: open talus slopes, cliff, limestone gulches, w. of Tilford, June 19, 1924, *McIntosh 307* (RM); rocky, open ground, near Piedmont, June 8, 1929, *Palmer 37032* (G, M). LAWRENCE CO.: rocky, open slopes, near Tilford, June 16, 1929, *Palmer 37322* (G). PENNINGTON CO.: foot of Great Wall, 3½ mi. from Interior, Bad Lands, Black Hills, 1927, *Hayward 711* (F); red-bed foothills, east-facing, Rapid City, June 12, 1927, *Hayward 798* (RM); foothills, Rockerville, Black Hills, June 15–30, 1909, *White* (M). CUSTER CO.: red-bed foothills, Fairburn, Black Hills, 1927, *Hayward 1477* (F); red-bed foothills, Buffalo Gap, Black Hills, 1927, *Hayward 1515* (F). SHANNON CO.: Pine Ridge, June 20, 1901, *Bates* (G). FALL RIVER CO.: Hot Brook Creek, Hot Springs, Black Hills, 1927, *Hayward 1616* (F); red-bed foothills, Hot Springs, Black Hills, June 28, 1927, *Hayward 1622* (F, RM); Fall River Falls, Black Hills, 1000 m. alt., June 19, 1892, *Rydberg 1047* (NY).

NEBRASKA. SIOUX CO.: on dry slopes and in gumbo, 1927, *Kramer 80* (M); Munro Canyon, Harrison, June 20, 1930, *Osterhout 7215* (RM). DAWES CO.: White River, near Crawford, 1200 m. alt., June 8, 1901, *MacDougal 116* (NY).

MONTANA. DAWSON CO.: Glendive, June, 1907, *Butler 5015* (NY); Intake, June

17, 1937, *Twedt 29* (UM). FALLON CO.: Plevna, June 18, 1937, *Sparks 992* (UM). CUSTER CO.: Miles City, June 8, 1937, *Roberts 934* (M, UM); sandy loam, No. 3 Well, 705 m. alt., June 2, 1936, *Woolfolk* (UM). FERGUS CO.: Grass Range, July 29, 1937, *Munson 1021* (UM). MUSSELSHELL CO.: Gage, June 17, 1937, *Lackey 629* (UM); rocky soil, Roundup, 1020 m. alt., June 14, 1937, *Syblon 973* (UM). YELLOWSTONE CO.: Custer, June 8, 1890, ex herb. *Blankinship 61* (G, M); dry bluff, Billings, June 29, 1905, *Whited 2661* (UO). BIG HORN CO.: plains near Decker, May 23, 1934, *Rollins 451* (WS); Fort Custer, June, 1890, *Tweedy* (NY).

WYOMING. CROOK CO.: foothills, Inyan Kara Creek, 17 mi. s. of Sundance, Black Hills, July 14, 1927, *Hayward 2113* (F, RM); dry hillsides, w. of Hulett, June 13–23, 1938, *Ownbey 404* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS). WESTON CO.: western foothills, Newcastle, July 9, 1927, *Hayward 2037* (F, RM). CAMPBELL CO.: sagebrush slopes, Gillette, July, 1928, *Beatty 7* (RM). CONVERSE CO.: dry plains, 6 mi. w. of Douglas, 1440 m. alt., July 2, 1935, *Ownbey 788* (O, RM); same locality and date, *Williams 2312* (M, UC, WS). ALBANY CO.: gulches among *Artemisia cana*, Rock River, 2100 m. alt., July 5, 1914, *Macbride 2752* (RM); stony sagebrush slopes, Chug Creek, June 29, 1900, *Nelson 7304* (RM). SHERIDAN CO.: Big Horn Mts., 2250 m. alt., July, 1899, *Tweedy 2560* (NY). NATRONA CO.: dry foothills, Casper Mt., 3 mi. s. of Casper, 1650 m. alt., July 6, 1933, *Hermann 4564* (G). CARBON CO.: dry, rocky hillsides, Indian Creek, June 24, 1901, *Goodding 96* (D, F, G, M, NY, P, RM, UC); rocky areas, sagebrush and grassland, Red Valley, near Muddy Gap, June 16, 1932, *Hanna 999* (M); Elk Mt., 2550 m. alt., June 28–Aug. 1, 1899, *Little & Stanton 166* (M, NY); Seminole Mts., July 21, 1898, *Nelson 4926* (RM); Cow Creek, 11 mi. n. of Encampment, July 2, 1922, *Payson & Payson 2521* (RM). PARK CO.: sandy, rocky plain, Little Rocky, Clarks Fork Valley, 1500 m. alt., June 23, 1924, *Pearson & Pearson 52* (RM). FREMONT CO.: in sagebrush draws, Birds Eye, June 24, 1910, *Nelson 9345* (M, RM, UC), *9346* (RM, UC). SUBLETTE CO.: sagebrush flat, 20 mi. w. of Big Piney, July 9, 1922, *Payson & Payson 2623* (G, M, RM, UC); sagebrush slope, Horse Creek, 7 mi. w. of Merna, July 17, 1922, *Payson & Payson 2736* (G, M, NY, P, PA, RM, UC); sagebrush slopes, near Cora, 2280 m. alt., July 10, 1925, *Payson & Payson 4342* (G, M, PA, RM, WS). SWEETWATER CO.: dry soil, near Leucite Hills, July 1, 1901, *Merrill & Wilcox 789* (G, NY, RM). TETON CO.: dry flats, Teton Pass Mts., e. of Victor, Idaho, 2100 m. alt., July 22, 1920, *Payson & Payson 2093* (CA, G, M, NY, RM). LINCOLN CO.: dry hillside, Alpine, on the Snake River, near the Idaho Boundary, July 10, 1923, *Payson & Armstrong 3435* (G, M, P, PA, RM). UINTA CO.: Bridger Butte, July 7, 1873, *Porter* (PA).

COLORADO. ROUTT CO.: Hayden, June 24, 1914, *Osterhout 5097* (RM). EAGLE CO.: sagebrush slopes, Route 11, 2 mi. s. of State Bridge, 2160–2190 m. alt., June 27, 1938, *Pennell & Schaeffer 22279* (PA). RIO BLANCO CO.: south side of White River, 2 mi. s. e. of mouth of Wolf Creek, 1680 m. alt., June 2, 1935, *Graham 9076* (M). GARFIELD CO.: Glenwood Springs, June 20, 1895, *Meredith 4535* (PA); Glenwood Springs, June 17, 1899, *Osterhout 1967* (RM). MESA CO.: Grand Junction, May, 1891, *Eastwood* (F, WS); Gunnison Mesa, Grand Junction, May 15, 1916, *Eastwood 5129* (CA); Grand Junction, *Eastwood* (D); Grand Junction, May 22, 1895, *Jones* (D, P); De Beque, May 26, 1910, *Osterhout 4257* (RM). DELTA CO.: hill, Surface and Dry creeks, Grand Mesa, 1830 m. alt., June, 1892, *Purpus 59* (F). MONTROSE CO.: Cimarron, 2070 m. alt., June 29, 1901, *Baker 285* (G, M, NY, P, RM, UC); dry hillsides, Montrose, May 15, 1911, *Payson 8* (RM); rocky soil,

hilltop, 10 mi. s. of Montrose, 1800 m. alt., May 24, 1938, *Rollins 2132* (O); dry, rocky foothills, Paradox, 1860 m. alt., July 10, 1912, *Walker 214* (RM). LA PLATA CO.: Durango, May 21, 1916, *Eastwood 5347* (CA). MONTEZUMA CO.: sage plains, Mancos, June 22–July 8, 1898, *Baker, Earle & Tracy 1125, in part* (G, RM); just e. of Cortez, 1800–1950 m. alt., May 25, 1934, *McKelvey 4646* (G); Wickiup Canyon, Mesa Verde National Park, 1920 m. alt., May 30, 1925, *Schmoll 1634* (RM); sandstone, between Cortez and Mancos, 1890 m. alt., May 25, 1934, *Stone 479* (NY); Mancos, 2100 m. alt., May 27–June 8, 1901, *Vreeland 838* (NY, UM).

NEW MEXICO. RIO ARRIBA CO.: open woods, Dulce, June 18, 1932, *Castetter 2038* (RM). SAN JUAN CO.: Bloomfield, 1892, *Waring 37* (PA).

IDAHO. BANNOCK CO.: Pocatello, May 15, 1935, *Davis* (G, M, O); Pocatello, June 7, 1910, *Heller* (CA); Pocatello, June 11, 1902, *Jones* (P); Pocatello, Spring, 1921, *Soth P-57* (RM).

UTAH. UINTAH CO.: Davis Hollow, Taylor Mt., 15 mi. n. of Vernal, Uinta Basin, 2550 m. alt., June 24, 1931, *Graham 6361* (F); Vernal-Manila Road, n. of Vernal, Uinta Basin, 1950 m. alt., June 19, 1933, *Graham 8166* (M); among prickly pears, about 15 mi. s. of Jensen, Uinta Basin, 1650 m. alt., May 27, 1935, *Graham 9000* (F, G, M); along Highway 40, 10 mi. e. of Jensen, Uinta Basin, 1500 m. alt., May 31, 1935, *Graham 9029* (G); bench, 5 mi. e. of Vernal, Diamond Mt. Road, Uinta Basin, 1650 m. alt., June 8, 1935, *Graham 9139* (M); Red Wash, just n. w. of mouth of Split Mt. Canyon, above Island Park, Uinta Basin, 1560 m. alt., June 10, 1935, *Graham 9158* (M); Ouray, 1650 m. alt., May 22, 1908, *Jones* (P); dry, heavy or limy soil, among sagebrush, foothills of the Uinta Mts., 18 mi. n. of Vernal, Uinta Basin, 2100 m. alt., June 14, 1937, *Rollins 1691* (G, M, NY, O); desert, w. of Vernal, June 12, 1932, *Williams 609* (CA, M, NY, RM). GRAND CO.: Cisco, May 2, 1890, *Jones* (M, NY, P, UC); Westwater, May 20, 1901, *Jones* (D, G, P). SAN JUAN CO.: in fields and among junipers, 5 mi. n. of Blanding, June 22, 1938, *Cutler 2344* (M, O); yellow pine zone, Navajo Mt., 2700 m. alt., June, July, 1933, *Darsie* (UCLA). SUMMIT CO.: dry ground amongst sagebrush, near Bear River, 2460 m. alt., July 9, 1931, *Goodman 1868* (G, M, NY); edge of drying lake, West Fork of the Bear River, Uinta Mts., 2490 m. alt. July 9–13, 1930, *Goodman & Hitchcock 1549* (D, M, NY, UC). CARBON CO.: gravel, Castle Gate, 1800 m. alt., June 23, 1894, *Jones 5486* (P); Scofield, 2700 m. alt., 1905, *Jones* (P); Miller Creek, 1800 m. alt., June 8, 1910, *Jones* (D, P, UM). GARFIELD CO.: in yellow pine and sagebrush, Ruby's Inn, near checking station, Bryce Canyon National Park, July 8, 1937, *Ferris & Lorraine 9344* (D); 6 mi. w. of Panguitch Lake, 2700 m. alt., July 17, 1930, *Goodman & Hitchcock 1588* (CA, D, F, M, NY, PA, RM, UC, UM); Bryce Canyon, July 10, 1932, *Hawver* (CA); gravel, Mt. Ellen, Henry Mts., 2850 m. alt., July 25, 1894, *Jones 5684* (P); gravel, Bromide Pass, Mt. Ellen, Henry Mts., 3000 m. alt., July 27, 1894, *Jones 5695* (P); Bryce Canyon, June 27, 1913, *Jones* (D); Bryce Canyon, June, 1923, *Rodda* (CA); Aquarius Plateau, at the head of Poison Creek, Aug. 4, 1905, *Rydberg & Carlton 7434* (NY, RM). KANE CO.: summit of rim above Johnson, June 21, 1890, *Jones* (P); red sand, Kanab, 1590 m. alt., May 22, 1894, *Jones 5276* (M, NY, P, UC); Pahnah, 1883, *Siler* (M, PA); sandstone, 2 mi. n. e. of Kanab to Red Canyon, 1560 m. alt., May 14, 1934, *Stone 277* (NY). CACHE CO.: Mendon, June 17, 1898, *Mulford 119* (M); College Bench, Logan, June 2, 1910, *Smith 2169* (D); e. of Utah Agricultural College, Logan, May 28, 1910, *Zundel 211* (D, NY). WEBER CO.: Ogden, July 1, 1880, *Engelmann* (M); Ogden, June 5,

1871, *Hayden* (PA). SALT LAKE CO.: Salt Lake City, 1290 m. alt., June 10, 1880, *Jones 1766* (CA, F, NY, P); foot of Oquirrh Mts., July 3, 1917, *Moore* (PA); hills and mountains n. of Salt Lake City, June 9, 1905, *Rydberg 6004* (G, NY). UTAH CO.: American Fork Canyon, June 16, 1933, *Eastwood & Howell 556* (CA). SEVIER CO.: Manti Stock Company Pasture, Fish Lake Forest, 2900 m. alt., July 18, 1919, *Eggleston 15281* (F); gravel, 4 mi. up Salina Canyon, 1590 m. alt., June 14, 1894, *Jones 5419* (P); stony loam among junipers and sagebrush, Route 10, Salina Canyon, s. e. of Salina, 1860–1920 m. alt., June 21, 1938, *Pennell & Schaeffer 21977a* (PA); Richfield, 1500 m. alt., June 5, 1875, *Ward* (G). TOOELE CO.: Johnsons Pass, Cottonwood, 1680 m. alt., June 6, 1900, *Jones* (P); Mt. Ibapah, 2100 m. alt., July 17, 1903, *Jones* (P); summit of Oquirrh Mts., Aug. 3, 1917, *Jones 344* (G). JUAB CO.: under low shrubs, 2 mi. s. of Tintic, June 26, 1938, *Cutler 2431* (M, O); sagebrush land, Juab, June 9, 1902, *Goodding 1056* (RM). MILLARD CO.: Leamington, 1500 m. alt., May 8, 1911, *Jones* (P). IRON CO.: high mountains, e. of Cedar City, 1874, *Parry 255* (F, M, (PA). WASHINGTON CO.: dry desert, Belveau, 990 m. alt., June 1, 1929, *Cottam, Stanton & Harrison 3992* (P); on way to Pine Valley, near St. George, June 27, 1933, *Eastwood & Howell 1212* (CA, UM); red loam, among junipers, w. of Pine Valley, 1710–1770 m. alt., June 15, 16, 1938, *Pennell & Schaeffer 21748* (PA).

ARIZONA. COCONINO CO.: Bright Angel Trail, Grand Canyon of the Colorado River, June 15, 1916, *Eastwood 5654* (CA); Kaibab Forest, July 7, 1927, *Jaeger* (P); Kaibab, June 17, 1930, *Jones 25179* (P); Kaibab, June 18, 1929, *Jones 26103* (P); stony limestone, among junipers and pinyons, Route 89, n. of Jacob Lake, Kaibab Plateau, 2010–2040 m. alt., June 10, 1938, *Pennell 21633* (PA). MOHAVE CO.: oak association, dry hillside, Mt. Delenbaugh, 2100 m. alt., June 6, 1929, *Cottam, Stanton & Harrison 4150* (P); Trumbull, 1877, *Palmer 452* (G, NY).

NEVADA. WHITE PINE CO.: Muncy, July 2, 1891, *Jones* (M); gravelly sagebrush, along Steptoe Creek, e. of Shell Creek Mts., 2100–2250 m. alt., July 15, 1938, *Pennell & Schaeffer 23079* (PA); sagebrush, along Lehman Creek, below Mt. Wheeler, 2220–2280 m. alt., July 15–18, 1938, *Pennell & Schaeffer 23094* (PA). CLARK CO.: Kyle Canyon, Charleston Mts., 2270 m. alt., July 5, 1936, *Clokey 7043* (Clokey); Charleston Park, Charleston Mts., 2270 m. alt., July 11, 1936, *Clokey 7047* (Clokey); same locality, July 21, 1937, *Clokey 7479* (M), type collection of *C. rhodotheeus* Clokey; Kyle Canyon to Deer Creek, Charleston Mts., 2400 m. alt., July 17, 1937, *Clokey 7480* (Clokey, M, O); Harris Springs Road, Charleston Mts., 1800 m. alt., June 17, 1937, *Clokey 7482* (Clokey); Lee Canyon, Charleston Mts., 2000 m. alt., July 3, 1936, *Clokey & Clokey 7044* (Clokey); Kyle Canyon to Deer Creek, Charleston Mts., 2425 m. alt., July 3, 1936, *Clokey & Clokey 7045* (Clokey); Griffith's Mine Road, Charleston Mts., 2425 m. alt., July 7, 1936, *Clokey & Clokey 7046* (Clokey, M, O); Kyle Canyon, Charleston Mts., 2700–3300 m. alt., July 22, 1930, *Goodman & Hitchcock 1672* (CA, D, M, NY, PA, UC, UM); stony ground, pinyon association, Kyle Canyon, 2250 m. alt., June 6, 1921, *Jaeger* (P, UCLA); Trout Creek, west base of Charleston Mts., 2100 m. alt., June 26, 1926, *Jaeger* (P). LANDER CO.: Bunker Hill Canyon, Toiyabe Range, July 29, 1913, *Kennedy 4095* (D); Birch Creek, Toiyabe Range, July 31, 1913, *Kennedy 4580* (D).

STATE NOT DETERMINED. "Towards the sources of the Columbia," *Wyeth* (NY, PA), TYPE COLLECTION.

35a. Calochortus Nuttallii var. **bruneaunis** (Nelson & Macbride) Ownbey, n. comb.

Calochortus bruneaunis Nelson & Macbride in Bot. Gaz. **55**: 372. 1913.

Calochortus discolor Davidson in Bull. So. Calif. Acad. **14**: 11. 1915.

Petals usually narrowly oblanceolate and conspicuously acuminate, with a median, longitudinal, green stripe and a dark red or purple spot above the gland, glabrous or occasionally with a few short hairs near the gland; anthers yellowish, bluish or reddish brown; otherwise as in the species.

The morphological characters which distinguish this variety from *C. Nuttallii* are not great, but, when supplemented by its geographical distribution, seem to merit taxonomic recognition.

DISTRIBUTION. Dry soil, southwestern Montana, southwestward across Idaho and southeastern Oregon to Nevada and adjacent California.

MONTANA. MADISON CO.: Cliff Lake, 2100 m. alt., July 27, 1897, *Rydberg & Bessey 3873* (NY).

IDAHO. FREMONT CO.: Henrys Fork, Snake River, 1872, *Coulter 585* (PA); among *Artemisia* bushes, in a draw, near Ashton, July 8, 1937, *Detling 2237* (UO). CLARK CO.: 3 mi. s. w. of Small, 1620 m. alt., June 29, 1937, *Pennell 20614* (PA). BINGHAM CO.: Aberdeen, June 23, 1923, *Piper* (WS). CUSTER CO.: gravelly sagebrush slopes, Bear Canyon, Mackay, 2010 m. alt., July 31, 1911, *Nelson & Macbride 1425* (RM). BLAINE CO.: field along stream, Little Wood River, e. of Gannett, June 19, 1930, *Applegate 6329* (UC); Wapi, July 3, 1917, *Jones* (WS); dry, gravel flat, Bellevue, 1530 m. alt., June 30, 1916, *Macbride & Payson 2957* (CA, D, G, M, NY, P, UC); among sagebrush on dry slopes, Picabo, 1470 m. alt., July 1, 1916, *Macbride & Payson 3004* (G, M, NY, RM). CASSIA CO.: Albion, 1893, *Lyles* (UM). TWIN FALLS CO.: Twin Falls, *Armstrong 955* (NY); open slopes, Shoshone Falls, June 4, 1912, *Bennitt 118* (RM). WASHINGTON CO.: Weiser, May 12, 1914, *Stillinger* (UCLA). OWYHEE CO.: chipped-lava canyon sides, Hot Hole, East Bruneau, July 2, 1912, *Nelson & Macbride 1881* (G, RM TYPE).

UTAH. BOXELDER CO.: Copper Mt., 1800 m. alt., July 7, 1929, *Cottam 4553* (P).

OREGON. MALHEUR CO.: hills near the Malheur River, June 6, 1901, *Cusick 2544* (F, G, M, NY, P, RM, UC, UO); dry hills, John Day Highway, 4 mi. beyond Brogan, May 25, 1927, *Henderson 8827* (CA, UO); grassy hillsides, Mathew Valley, near Harper Ranch, 1100 m. alt., June 10, 1896, *Leiberg 2236* (F, G, UC). HARNEY CO.: flats, base of Steens Mts., near Alvord Desert, June 9, 1927, *Henderson 8828* (CA, PA, UO, WU); dry slopes, Cooney's Mine, Pueblo Mts., 1800 m. alt., July 3, 1927, *Henderson* (UO); Steens Mts., June, 1927, *Leach* (WU); dry ground, 7 mi. s. of French Glen, June 21, 1936, *Peck 18963* (WU); dry slope, lower Willow Creek Canyon, June 23, 1936, *Peck 18982* (WU).

NEVADA. ELKO CO.: Clover Mts., near Deeth, 1980 m. alt., July 22, 1908, *Heller 9087* (NY, PA); Star Canyon, s. e. of Deeth, 1710 m. alt., July 10, 1912, *Heller 10580* (D, G, NY); Wendover [town in Utah, but specimen labelled "Nevada"], June 24, 1929, *Jones 26104* (P); Lone Mt., 2250 m. alt., Aug. 5, 1913, *Kennedy 4471* (D, PA); East Humboldt Mts., 2400 m. alt., Aug., 1868, *Watson 1173, in part* (NY). HUMBOLDT CO.: ridge of Pine Forest Mts., 1500 m. alt., June 21, 1909, *Taylor & Richardson 69* (UC). PERSHING CO.: Unionville, 1500 m. alt., June, 1868, *Watson 1172* (G, NY). WASHOE CO.: Reno, May 24, 1901, *Cowgill* (RM, UC); Peavine Mt., June 22, 1909, *Heller 9753* (D, UC); Reno, *Hillman* (P); Newcomb Lake, June 8, 1901, *Kennedy 13* (UC); Verdi, May 20, 1888, *Sonne* (UC); with *Artemisia tridentata* and pinyon pine, hills near Steamboat Springs, June 7, 1930, *Van Dyke* (CA). ORMSBY CO.: Empire City, June 19, 1882, *Jones* (P); Carson City, 1500 m. alt., May 29, 1897, *Jones* (P); south of Carson City, 1500 m. alt., June 2, 1897, *Jones* (D, NY).

CALIFORNIA. LASSEN CO.: Honey Lake, July 24, 1892, ex herb. *Brandegee* (UC). MONO CO.: 3 mi. from Mammoth Camp, July 19, 1918, *Ferris 1427* (D); Mono Lake, July 2, 1917, *Wright* (CA). INYO CO.: Andrews Camp, Bishop Creek, July, 1911, *Davidson 2672* (M), type collection of *C. discolor* Davidson; open hillside among bushes, Westgard Pass, 2190 m. alt., June 11, 1937, *Grinnell & Grinnell 1043a* (UC); coarse granite sand, foothills w. of Bishop, May 23, 1906, *Heller 8328* (CA, D, F, G, M, NY).

35b. **Calochortus Nuttallii** var. **panamintensis** Ownbey, n. var.[39]

Stem slender, tall; petals without a spot, white or faintly lilac, with a median, longitudinal, green stripe; anthers bluish or reddish; otherwise as in the species.

This variety seems to be a constant and easily distinguishable local variant.

DISTRIBUTION. California: dry slopes, Panamint Mountains, Inyo County.

CALIFORNIA. INYO CO.: Wild Rose Canyon, Water Canyon, above Thorndyke's Ranch, Panamint Mts., 2250–2550 m. alt., July 7, 1937, *Epling* (UCLA); Telescope Peak, near saddle at fork of Eagle Spring Trail, Panamint Mts., 3000 m. alt., July 8, 1937, *Epling* (UCLA); rocky slopes above Wild Rose Canyon, Panamint Mts., June 20, 1931, *Hoffmann 477* (CA); sandy soil among rocks, south side of Surprise Canyon, near Panamint City, Panamint Mts., 2400 m. alt., June 14, 1928, *Howell 3900* (CA); dry slope, Thorndyke's Canyon, upper Wild Rose Canyon, Panamint Mts., 2310 m. alt., July 7, 1937, *Munz 14856* (M, P TYPE).

35c. **Calochortus Nuttallii** var. **aureus** (Watson) Ownbey, n. comb.

Calochortus aureus Watson in Am. Nat. **7**: 303. 1873.

[39] **Calochortus Nuttallii** var. **panamintensis** var. nov., caule gracili alto; petalis sine macula albis aut sublilacinis, linea viridi mediana longitudinali; antheris subcaeruleis aut subrubris; aliter similis speciei.

Petals lemon-yellow, with a maroon blotch above the gland; stems usually short, with a large bulblet near the base; otherwise exactly as in the species.

This variety is hardly more than a color form, but it is easily separated, and seems to have a distinct geographical range.

DISTRIBUTION. Northwestern New Mexico, across southern Utah and northern Arizona.

NEW MEXICO. MCKINLEY CO.: in fields, 7 mi. w. of Ramah, June 19, 1938, *Cutler 2117* (M, O); Gallup, June 14, 1916, *Eastwood 5606* (CA); Fort Wingate, May, *Kimball* (M); not far w. of Gallup, May 22, 1934, *McKelvey 4595, 4600* (G); Fort Wingate, 1881, *Matthews 23* (G).

UTAH. EMERY CO.: dry hillside, King Ranch, 1500 m. alt., April 30, 1931, *without collector 5575* (M). KANE CO.: Kanab, *Thompson* (G, TYPE). COUNTY NOT DETERMINED: "S. Utah," 1873, *Bishop* (G); "S. Utah," 1874, *Siler* (G).

ARIZONA. APACHE CO.: desert region, s. of Petrified Forest, May 27, 1935, *Nelson & Nelson 2168* (M, NY); sandstone, near Lupton, New Mexican Line, 1800 m. alt., May 22, 1934, *Stone 450* (NY). NAVAJO CO.: n. of Holbrook, May, 1931, *Braem 36* (D); between Holbrook and Lupton, May 22, 1934, *McKelvey 4586, 4592* (G); 5 mi. e. of Holbrook, 1650 m. alt., May 22, 1934, *Stone 436* (NY). COCONINO CO.: Moqui Village, Aug., 1891, *Owens* (G). COUNTY NOT DETERMINED: Bat Woman Canyon, Navajo Reservation, 2100 m. alt., June, July, 1933, *Darsie* (UCLA).

36. Calochortus invenustus Greene, Pittonia **2**: 71. 1890.

Calochortus Nuttallii var. *australis* Munz, Man. So. Calif. Bot. pp. 94, 597. 1935.

Bulb ovoid, with membranaceous coats; stem slender, erect, rarely branched, usually with a large, solitary bulblet in the pouch-like sheath of the lowest cauline leaf; leaves linear, reduced upward, becoming involute; inflorescence 1–5-flowered, subumbellate, the bracts congested, unequal; flowers erect, campanulate, white or dull lavender to greenish gray, sometimes with a purple spot on the claw of each petal; sepals shorter than the petals, lanceolate, acute to acuminate, glabrous or with a few hairs at the base; petals obovate, cuneate, obtuse to short-acuminate, invested near the gland with a few short hairs; gland small, circular, slightly depressed, surrounded with a more or less continuous, fringed membrane, and densely covered with short, usually distally branched processes; anthers oblong, obtuse, purplish or yellowish, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-

lanceolate, acute, 3-angled, erect; seeds flattened, with loose-fitting, hexagonally reticulate coats.

Calochortus invenustus is closely allied to *C. Nuttallii,* with which it has been confused. While the morphological differences are not great, it is readily distinguished by the absence of a spot on the petals above the gland, the color of the petals, its different habit and its geographical range.

DISTRIBUTION. California: in dry soil, in the mountains, from Santa Clara County southward to San Diego County; also in the southern Sierra Nevada; infrequent north of the Tehachapi Range, but common southward.

CALIFORNIA. TUOLUMNE CO.: Tioga Road, w. of Lake Tenaya, 2370 m. alt., Aug. 23, 1916, *Smiley 875* (G). TULARE CO.: Little Kern, July 7, 1916, *Campbell* (CA); Little Kern River, Aug. 2, 1904, *Culbertson 4331* (G, M, P); Soda Creek, head of Kern River, 1950–2250 m. alt., July 17, 1897, *Dudley 1940* (D); Natural Bridge of Volcano Creek, basin of the upper Kern River, 2250 m. alt., July, 1904, *Hall & Babcock 5426* (UC); 1 mi. e. of Long Meadow, Sierra Nevada, 2250 m. alt., July 17, 1911, *Taylor* (UC) SANTA CLARA CO.: rock outcrop above Colorado Creek, Red Mts., Mt. Hamilton Range, 750 m. alt., May 25, 1936, *Sharsmith 3804* (O). MONTEREY CO.: Tassajara Springs, May 30, 1926, *Durbrow* (CA); Tassajara Hot Springs, June, 1901, *Elmer 3216* (D, M, UO); in pine woods, Santa Lucia Mts., 1416 m. alt., June 27, 1929, *Rountree* (P). KERN CO.: in the mountains back of Fort Tejon, July 7, 1891, *Coville & Funston* (UC); gravel bank, Tehachapi Trail, Brook Glen, region of Tehachapi Peak, Tehachapi Mts., 1800–2400 m. alt., June 24, 1895, *Dudley 327* (D, NY, UC); dry slope, under pines, head of Cuddy Valley, Mt. Pinos, T. 9 N., R. 21 W., July 3, 1938, *Ownbey & Ownbey 1690* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UM, UO, WS). VENTURA CO.: below old saw mill, Mt. Pinos, 2100 m. alt., June 19, 1896, *Dudley & Lamb 4603* (D, UC); Griffins, Mt. Pinos, July, 1902, *Elmer 3981* (D, F, G, M, NY, P); Mt. Pinos, June 8, 1931, *Epling & Dunn* (UCLA); Mt. Pinos, 2250 m. alt., June 27, 1931, *Epling & Dunn* (F, M, PA, UC, UCLA); Seymour Creek, Mt. Pinos, 2250 m. alt., July, 1905, *Hall 6506* (UC); Mt. Pinos, July 4, 1922, *Hart 19* (CA). LOS ANGELES CO.: North Baldy Mt., San Gabriel Mts., 2400 m. alt., July 3, 1908, *Abrams & McGregor 602* (D); Swartout Canyon, desert slopes of San Gabriel Mts., 1800 m. alt., July 5, 1908, *Abrams & McGregor 635* (D); Summit Mt., San Gabriel Range, July 11, 1897, *Barber 253* (UC); south slope of Mt. San Antonio, San Gabriel Mts., 2850 m. alt., July 28–30, 1930, *Goodman & Hitchcock 1723* (M); Barley Flats, San Gabriel Mts., 1680 m. alt., July 8, 1917, *Grinnell* (D, P); San Antonio Peak, 2700 m. alt., Aug. 8, 1926, *Jones* (P); on dry slopes, among sagebrush and pines, Swartout Valley, San Antonio Mts., 1800 m. alt., June 17, 1921, *Munz 4651* (P); summit of San Antonio Mts., 2979 m. alt., Aug., 1914, *Surr* (D); above Pine Flats, North Fork of San Gabriel Canyon, July 12, 1930, *West, Sweet & Crow* (P). SAN BERNARDINO CO.: dry ridges, Coldwater Canyon, San Antonio Mt., 2100 m. alt., July 12, 1902, *Abrams 2719* (NY); Deep Creek, San Bernardino Mts., 1800 m. alt., July 8, 1908, *Abrams & McGregor 730* (D); open pine forest, Hunsacker Flat, San Bernardino Mts., 1500 m. alt., July 23, 1897, *Chandler* (UC); Mare Flats, San Bernardino Mts., 2400 m. alt., July 6, *Crawford* (P); Bear Val-

ley, San Bernardino Mts., June 1, 1916, *Edwards* (P); rocky slope, Gold Mt., above Baldwin Lake, 2200 m. alt., June 19, 1932, *Fosberg 8503* (P); dry hillsides, Fish Creek, San Bernardino Mts., 1950 m. alt., June 26, 1905, *Grinnell 29* (UC); black oak belt, Fish Creek, San Bernardino Mts., 2100 m. alt., June 30, 1906, *Grinnell & Grinnell 253* (CA); Hunsacker Flat and Deep Creek, San Bernardino Mts., 1800 m. alt., July 20, 1899, *Hall* (NY); Lytle Creek Canyon, San Antonio Mts., 1800 m. alt., June 1–3, 1900, *Hall 1452* (D, M, UC); near South Fork Meadows, Santa Ana Canyon, San Bernardino Mts., 2340 m. alt., Aug. 3, 1906, *Hall 7655* (UC); dry ground, Big Bear Valley, 1950 m. alt., July 4, 1920, *Harwood 4354* (P); Bear Valley, San Bernardino Mts., June 22, 1926, *Hilend 78* (UCLA); upper Holcomb Valley, San Bernardino Mts., June 25, 1930, *Hilend 571* (UCLA); around the east end of Big Bear Lake, San Bernardino Mts., 2010 m. alt., July 10, 1927, *Howell 2733* (CA); dry ridge, Bear Flats Trail to Baldy, San Antonio Mts., 2100–2550 m. alt., July 4, 1917, *Johnston 1379* (D, UC); bare ridge, Ontario Peak, San Antonio Mts., 2550 m. alt., July 30, 1917, *Johnston 1606* (D, P, UC); Bear Valley, San Bernardino Mts., 1980 m. alt., July 19, 1900, *Jones* (P); Bear Lake, San Bernardino Mts., June 24, 1926, *Jones* (D); dry, rocky slope at east end of Baldwin Lake, Bear Valley, San Bernardino Mts., 2100 m. alt., June 13, 1922, *Munz 5749* (P); on dry, pine-covered slopes, Kelly's Cabin, near Ontario Peak, San Gabriel Mts., 2430 m. alt., July 18, 1922, *Munz 6073* (P, UC); in meadow, Coldwater Fork of Lytle Creek, San Gabriel Mts., 2100 m. alt., July 19, 1922, *Munz 6109* (P); dry slopes at east end of Bear Lake, 1980 m. alt., June 22, 1926, *Munz 10469* (P); dry slope, Fredalba, San Bernardino Mts., 1500 m. alt., June 8, 1919, *Munz & Johnston 2919* (P); under pines, divide above Big Meadows, San Bernardino Mts., 2430 m. alt., July 16, 1924, *Munz & Johnston 8636* (P); canyon above Big Meadows, San Bernardino Mts., 2160 m. alt., July 16, 1924, *Munz & Johnston 8651* (P, type of *C. Nuttallii* var. *australis* Munz); dry slopes, Van Dusen Canyon, near Big Bear Lake, San Bernardino Mts., June 29, 1938, *Ownbey & Ownbey 1670* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC); Lone Valley, San Bernardino Mts., 1800 m. alt., June 17, 1894, *Parish 3158* (M); Bear Valley, San Bernardino Mts., 1950 m. alt., June 18, 1894, *Parish 3159* (G, M, NY, PA, UC); Bear Valley, June, 1895, *Parish* (D); dry canyon bed, Coldwater Fork of Lytle Creek, San Antonio Mts., June 21, 1922, *Pierce* (P); Bear Valley, San Bernardino Mts., June 26, 1922, *Pierce* (P); dry hills, San Bernardino, 300 m. alt., May 7, *Spencer 1353a* (G, NY); San Bernardino Mts., June, 1928, *Van Dyke* (CA); Forest Home, San Bernardino Mts., 1590 m. alt., July, 1928, *Van Dyke* (CA); dry woods, Glen Martin, 1500 m. alt., Aug., 1904, *Williamson* (PA). RIVERSIDE CO.: on trail to Tahquitz Peak, San Jacinto Mts., 1740 m. alt., July 2, 1925, *Bacigalupi 1243* (D); San Jacinto Mts., 2550 m. alt., June 22, 1910, *Condit* (UC); above Marion Camp, Mt. San Jacinto, June 30, 1935, *Epling & Robison* (UCLA); Strawberry Valley, San Jacinto Mts., 1800 m. alt., June 17, 1897, *Hall 642* (UC); in open pine forests, vicinity of Strawberry Valley, San Jacinto Mts., 1560–1800 m. alt., June, July, 1901, *Hall 2297* (D, UC); in meadows and bogs of Tahquitz Valley, San Jacinto Mts., 2670 m. alt., July, 1901, *Hall 2475* (UC); west slope of San Jacinto Peak, 2850 m. alt., July 26, 1928, *Meyer 546* (UC); dry benches near creek, Santa Rosa, Santa Rosa Mts., 1980 m. alt., June 27, 1922, *Munz 5856* (P, UC); dry slope under pines, Dark Canyon, San Jacinto Mts., 2250 m. alt., July 27, 1924, *Munz*

& Johnston 8776 (P); in open woods, Idyllwild, San Jacinto Mt., 1590 m. alt., June 20, 1919, *Spencer 1353* (CA, G, NY, P); on wooded hills, near Idyllwild, San Jacinto Mt., 1680 m. alt., June 16, 1922, *Spencer 2035* (P); near Round Valley, San Jacinto Mt., 2700 m. alt., July 18, 1923, *Spencer 2249* (P); Idyllwild, July 22–28, 1928, *Van Dyke* (CA). ORANGE CO.: Santiago Peak, June 15, 1901, *Abrams 1848* (D, P); dry, rocky summit, Santiago Peak, Santa Ana Mts., 1590 m. alt., June 14, 1923, *Munz & Keck 7093* (P). SAN DIEGO CO.: Laguna Mts., June 20, 1904, *Brandegee* (UC); near Garnet Peak, Laguna Mts., May 30, 1936, *Gander 2442* (P); Cuyamaca Mts., 900 m. alt., May, 1899, *Hall 1212a* (D); dry, gentle slopes, Laguna Camp, Laguna Mts., 1500 m. alt., June 25, 1924, *Munz 8380* (NY, P); in open woods, Laguna Mts., 1800 m. alt., June 20, 1920, *Spencer 1153* (G, P).

37. Calochortus excavatus Greene, Pittonia **2**: 71. 1890.
Calochortus campestris Davidson in Bull. So. Calif. Acad. **14**: 12. 1915.

Bulb ovoid, with membranaceous coats; stem slender, erect, unbranched, often bulbiferous near the base; leaves linear, reduced upward, the basal one persistent at anthesis; inflorescence 1–4-flowered, subumbellate, the bracts congested, unequal; flowers erect, broadly campanulate, apparently lavender, often with a purple spot at the base of each sepal and petal; sepals shorter than the petals, lanceolate, acute to acuminate, glabrous; petals broadly obovate, cuneate, usually obtuse or rounded above, invested near the gland with a few short hairs; gland circular, depressed, surrounded with a conspicuous, fringed membrane, and densely covered with short, distally branched processes; anthers oblong, obtuse, reddish brown, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-lanceolate, acute, 3-angled, erect; mature seeds unknown.

Calochortus excavatus is closely allied to *C. Nuttallii* and *C. invenustus*. From the former, it differs in its lack of a spot on the petals above the gland, its more slender habit, and different habitat. It may be separated from the latter by its leafier stems, persistent basal leaf, and smaller bulblets. The species of the subsection NUTTALLIANI are not distinguished by clear-cut morphological characters, and *C. excavatus* is perhaps the most unsatisfactory of the lot. The arguments for rec-

ognizing it as a species are: (1) It is a quite constant, morphologically distinguishable, and apparently natural entity. (2) It has a distinct geographical range. (3) Its habitat is unlike that of any other species of the subsection NUTTALLIANI. (4) Its inclusion under *C. Nuttallii*, even as a variety, would necessitate the similar inclusion of *C. invenustus*, and make the delimitation of species in the NUTTALLIANI even more difficult.

DISTRIBUTION. California: in grassy meadows, along Bishop and Lone Pine creeks, Inyo County.

CALIFORNIA. INYO CO.: Lone Pine Creek, Alabama Hills, April 26, 1936, *Cassel 158* (D); meadow of Lone Pine Creek, 1350 m. alt., May 27, 1906, *Hall & Chandler 7187* (UC); damp, grassy meadows near Bishop, May 30, 1906, *Heller 8350* (CA, D, F, G, M, NY, PA, UC); Lone Pine, 1800 m. alt., May 14, 1897, *Jones* (D, NY, P); Bishop Creek, May 30, 1886, *Shockley 427* (G, UC), TYPE COLLECTION.

38. Calochortus concolor (Baker) Hort. acc. Purdy & Bailey in Bailey & Miller, Cyclop. Am. Hort. **1**: 220. 1900, as synonym; Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 135. 1901.

Calochortus luteus var. *concolor* Baker in The Garden **48**: 440, *pl. 1043*. 1895.

Bulb ovoid, with membranaceous coats; stem slender, erect, usually unbranched, rarely bulbiferous; leaves linear, becoming involute and curled at the tip, reduced upward; inflorescence 1–4-flowered, subumbellate, the bracts congested, unequal; flowers erect, campanulate, lemon-yellow, usually marked with a dark red blotch near the base of each sepal and a band on each petal above the gland; sepals shorter than the petals, lanceolate, acute to acuminate, glabrous; petals obovate, cuneate, rounded and obtuse above or abruptly acuminate, sparsely bearded above the gland with long, flexuous hairs; gland usually small, circular, depressed, surrounded by a broad, deeply fringed membrane, and densely covered with slender, usually unbranched processes; anthers oblong, obtuse, yellowish, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-lanceolate, acuminate, 3-angled, erect; mature seeds unknown.

This species closely resembles *Calochortus Nuttallii* var. *aureus*, and if the two were not widely separated geographi-

cally they might be easily confused. It is usually a much larger plant, however, with more densely hairy petals, and is rarely bulbiferous.

DISTRIBUTION. Dry slopes, southern face of the San Bernardino Mountains, San Bernardino County, California, southward to northern Lower California.

CALIFORNIA. SAN BERNARDINO CO.: Crafton, April, *Lemmon* (F, UC); Mill Creek Canyon, San Bernardino Mts., July 2, 3, 1892, *Parish 2524* (D, F, NY); Crafton Hills, July 1, 1903, *Williamson* (PA); Forest Home, San Bernardino Mts., 1590 m. alt., July, 1921, *Van Dyke* (CA). RIVERSIDE CO.: open south hillsides, El Toro Mt., San Jacinto Mts., 2490 m. alt., July 30, 1897, *Hall 962* (UC); eastern base of San Jacinto Mts., along the borders of the Colorado Desert, June, 1901, *Hall 2103* (D, M, NY, UC); exposed south slopes, vicinity of Chalk Hill, San Jacinto Mts., 1500 m. alt., June, 1901, *Hall 2285* (UC); McMullen Trail, San Jacinto Mts., June, 1921, *Jaeger* (P); 20 mi. n. of Idyllwild, June 20, 1926, *Jones* (P); dry rock crevices, Pipe Creek, Hemet Valley, San Jacinto Mts., 1440 m. alt., June 24, 1922, *Munz 5811* (P); dry and rocky slopes, between pines, Santa Rosa, Santa Rosa Mts., 1950 m. alt., June 30, 1922, *Munz 5917* (P, UC); dry slope, 10 mi. s. w. of Coahuila, May 21, 1927, *Munz 10875* (P); at the margins of the woods, Idyllwild, San Jacinto Mts., 1680 m. alt., June 16, 1922, *Spencer 2036* (P). SAN DIEGO CO.: dry ridges, 2 mi. w. of Jacumba, June 1, 1903, *Abrams 3682* (D, G, NY, P, PA); San Vicente Rancho, near Ramona, June, 1901, *Brandegee* (UC); Laguna Mts., June 20, 1904, *Brandegee* (UC); Warners Hot Springs, July, 1913, *Buttle* (CA); stony places among bushes, edge of desert, July 9, 1885, *Cleveland* (UC); Green Valley, near San Diego, June 27, 1915, *Collins & Kempton 197* (NY); Cuyamaca, June 25, 1919, *Eastwood 9141* (CA); Descanso, June 20, 1932, *Epling, Darsie, Knox & Robison* (UCLA); e. of Julian, May 30, 1926, *Jones* (NY, P); Descanso, May 31, 1926, *Jones* (P); Jacumba, May 31, 1926, *Jones* (P); Jacumba, Laguna Mts., June 10, 1917, *McGregor 990* (D); Banner, May 24, 1928, *Meyer 599* (UC); dry slope, Doane Valley, Palomar Mts., 1500 m. alt., June 22, 1924, *Munz 8313* (G, NY, P); high, dry slope, Laguna Camp, Laguna Mts., 1650 m. alt., June 25, 1924, *Munz 8355* (P); dry, stony slope, Vallecito Canyon, Laguna Mts., 1200 m. alt., May 17, 1925, *Munz 9724* (P); Campo, June 15, 1915, *Seitz* (CA); in the chaparral, Pine Hills, 1260 m. alt., June 24, 1917, *Spencer 602* (G, NY, P); in open woods, Laguna Mts., 1800 m. alt., June 20, 1920, *Spencer 1153A* (G, P); Santa Isabel Creek, June 10, 1895, *Stephens* (UC).

LOWER CALIFORNIA. Road between Ojos Negros and Alamos, 1110 m. alt., June 10, 1905, *Goldman 1137* (US); Nachoguero Valley, June 1, 1894, *Mearns 3377* (D, NY); Nachoguero Valley, June 4, 1894, *Mearns & Schoenefeldt 3471* (D); Hanson's Ranch, July 10, 1884, *Orcutt* (F, G).

39. Calochortus Kennedyi Porter in Bot. Gaz. 2: 79. 1877.

Calochortus speciosus Jones, Contrib. West. Bot. No. 14, p. 27. 1912.

Calochortus Kennedyi var. *Munzii* Jepson, Man. Fl. Pl. Calif. p. 236. 1923.

Bulb ovoid, with membranaceous coats; stem erect, often very short, usually unbranched, rarely bulbiferous; leaves glaucous, linear, attenuate, reduced upward; inflorescence 1–6-flowered, subumbellate, the bracts congested, unequal; flowers erect, campanulate, pale yellow, orange or vermillion, usually marked with dark purple or black near the base of the sepals and petals; sepals shorter than the petals, lanceolate, acute, usually glabrous; petals obovate, cuneate, usually rounded and obtuse above, invested near the gland with a few, distally thickened hairs; gland circular, slightly depressed, surrounded with a broad, fringed membrane, and densely covered with slender, simple or distally branched processes; anthers narrowly lanceolate, obtuse or acute, yellowish, dark purple or reddish brown, longer than the basally dilated filaments; ovary linear-lanceolate, not winged, tapering to a persistent, trifid stigma; fruit linear-lanceolate, acuminate, 3-angled, erect, longitudinally striped with purple; seeds strongly flattened, with loose-fitting, hexagonally netted coats.

Calochortus Kennedyi is closely allied to *C. Nuttallii*, but is distinguished by its smaller gland, yellow to vermillion flowers and more southerly distribution. In the western part of its range the flowers are uniformly vermillion, or sometimes orange, but eastward, the yellow form (variety *Munzii*) becomes more frequent, until in Arizona it is the prevailing form. The two color forms appear distinct in California, but in Arizona are not infrequently found growing together.

DISTRIBUTION. In dry, often rocky soil, deserts of central and southern Arizona and northern Sonora, to southeastern California.

ARIZONA. COCHISE CO.: Dragoon Mts., June, 1899, *Eby* (M). GILA CO.: near Apache Lodge, Roosevelt, Apache Trail Region, May 6, 1929, *Eastwood 16882* (CA); Apache Trail, near Roosevelt, May 5, 1929, *McKelvey* (CA). PINAL CO.: Oak Flats, between Miami and Superior, May 9, 1935, *Nelson & Nelson 1850* (M, NY). PIMA CO.: talus of lava butte, 15 mi. s. e. of Vail, April 7, 1932, *Fosberg 7937* (UCLA); dry hills, Covered Wells, April 7, 1932, *Fosberg 7938* (P, UC, UCLA); desert below White House Canyon, Santa Rita Mts., 1050 m. alt., April 16, 1928, *Graham 3622* (D); Baboquivari Mts., April 23, 1932, *Harrison & Kearney 8612* (P); between Sonoita and Vail, May 4, 1931, *McKelvey 2104* (G); stony hills, e. of Arivaca, April 11, 1935, *Nelson & Nelson 1468* (M, NY); Arivaca, 1095 m. alt., May 4, 1935, *Peebles & Fulton 11414* (F); mesas near Tucson, April 26, 1884, *Pringle* (F, PA); Santa Rita Mts., May 15, 1884,

Pringle (F, G, M, NY, PA). SANTA CRUZ CO.: dry, grassy hills, east slope of Tumacacori Mts., April 6, 1932, *Fosberg 7935* (M, P, UC, UCLA); rocky hillsides, between Ruby and the Tucson-Nogales Highway, April 13, 1935, *Nelson & Nelson 1503* (M, NY); Sonoita to Elgin, 1455 m. alt., May 5, 1935, *Peebles & Fulton 11479* (F). YAVAPAI CO.: dry elevations in moist valleys, Skull Valley, May 3, 1865, *Coues & Palmer 186* (M); Skull Valley, 1290 m. alt., April 28, 1903, *Jones* (P); Hillside, 1110 m. alt., May 1, 1903, *Jones* (D, P); Congress Junction, 900 m. alt., May 2, 1903, *Jones* (M, P); Congress, April 30, 1897, *Kunze* (NY); between Prescott and Ashfork, May 12, 1931, *McKelvey 2189* (G); Bloody Basin, midway between Fort Verde and Fort McDowell, April 21, 1888, *Mearns 203, in part* (NY); Fort Verde, 1884, *Mearns 258* (NY); near Prescott, May 14, 1927, *Peebles & Harrison 3984* (UCLA). MARICOPA CO.: Bush Highway, 1050 m. alt., May 12, 1935, *Collom 157, 377* (M); Wickenberg, 630 m. alt., May 5, 1903, *Jones* (P); stony slopes along the Apache Trail, May 1, 1935, *Nelson & Nelson 1701* (M, NY). MOHAVE CO.: n. of White Cliffs, vicinity of Kingman, April 9, 1927, *Braem* (D); hills e. of Kingman, May, 1933, *Braem* (D); Kingman, April 15, 1931, *Eastwood 18041* (CA); Hackberry, May 24, 1884, *Jones* (P); Chemehuevis, 1140 m. alt., April 23, 1903, *Jones* (D, NY, P); Hackberry, 1140 m. alt., April 25, 1903, *Jones* (P); Peach Springs, June, 1884, *Lemmon 4175* (G, UC); between Hackberry and Peach Springs, May 17, 1931, *McKelvey 2262* (G); Huapai Indian Reservation, Peach Springs to New Water Point on Colorado River, 1500 m. alt., April 29, 1934, *Stone 104* (NY); Peach Springs, May, 1893, *Wilson 109* (UC). YUMA CO.: Harcuvar Mts., April 21, 1932, *Peebles 8521* (F, UC).

NEVADA. ESMERALDA CO.: below Tule Canyon, Death Valley, June 4, 1891, *Bailey 2006* (D); Lida, June 4, 1924, *Jones* (P).

CALIFORNIA. INYO CO.: 15 mi. n. of Little Lake, May, 1927, *Fleisher* (CA); open hillside, between Deep Springs Valley and Oasis, 1911 m. alt., June 11, 1937, *Grinnell & Grinnell 1047a* (UC); gravelly hillside, near Dantes View, April 17, 1932, *Hitchcock 12345* (M, P, UC, UM); Wild Rose Canyon, Panamint Mts., 1950 m. alt., May 15, 1931, *Hoffmann 273* (P); Argus Mts., 1500 m. alt., May 11, 1897, *Jones* (P); among shrubs on dry flats, Wild Rose Canyon, Panamint Mts., 1800 m. alt., May 8, 1932, *Munz 12518* (P); dry bench, North Fork of Hanaupah Canyon, Panamint Mts., 1800 m. alt., May 7, 1932, *Munz 12542* (M, P); Mesa Mal Pais, Argus Mt., 1200–1500 m. alt., June, 1897, *Purpus 5013* (G, M, UC). SAN BERNARDINO CO.: south end of Providence Mts., April 12, 1930, *Barnes* (UCLA); Cottonwood Canyon, Providence Mts., May 8, 1931, *Barnes* (UCLA); Barnwell, May 16, 1911, *Brandegee* (UC); brushy hilltop, Mojave River at junction with Deep Creek, 900 m. alt., May 15, 1935, *Clokey & Anderson 6541* (M); same locality, May 19, 1935, *Clokey & Clokey 6993* (Clokey, F, M, NY, WS); near Hesperia, May 11, 1936, *Epling & Stewart* (UCLA); quartzite slopes, Johnston Grade, below Baldwin Lake, 2100 m. alt., June 19, 1932, *Fosberg 3502* (P); Victorville, 900 m. alt., May, 1905, *Hall 6193* (UC); Cajon Pass, May 10, 1926, *Hart 11* (CA); Cactus Flats, June 1, 1930, *Hilend 457* (UCLA); Mojave Desert, 12 mi. s. e. of Victorville, 900 m. alt., June 11, 1927, *Howell 2499* (CA); east slope of Clark Mt., June 10, 1933, *Jaeger* (P); open desert, w. of Deadman Point, May 16, 1920, *Johnston* (P); 9 mi. n. w. of Hesperia, May 17, 1920, *Johnston* (P); hillside, Mojave Desert, 3 mi. n. of Granite Well, May 14, 1922, *Johnston*

6487 (Clokey, P, UC); Victor, 780 m. alt., May 17, 1903, *Jones* (P); bridge on the Mojave, near Hesperia, May 7, 1926, *Jones* (CA, D); n. of and near Victorville, May 11, 1926, *Jones* (D, NY); Stoddards Well, Mojave Desert, May 7, 1927, *Jones* (P); sandy soil, benches along Mojave River at Deep Creek, 885 m. alt., May 15, 1935, *Keck & Stockwell 3288* (D); dry, rocky wash, Cactus Flats, San Bernardino Mts., 1800 m. alt., June 13, 1922, *Munz 5744* (P); dry flats, mouth of Deep Creek, north base of San Bernardino Mts., 900 m. alt., May 21, 1930, *Munz 11913* (P); open field, 10 mi. e. of Victorville, 870 m. alt., April 21, 1932, *Munz 12441* (M, P, UC); dry slopes above Vontrigger Spring, eastern Mojave Desert, 1050 m. alt., May 3, 1935, *Munz 13671* (D, F, P, UC); lower slope, vicinity of Bonanza King Mine, east slope of Providence Mts., Mojave Desert, 1200 m. alt., May 21–24, 1920, *Munz, Johnston & Harwood 4259* (D, P, UC), type collection of *C. Kennedyi* var. *Munzii* Jepson; among low shrubs, vicinity of Bonanza King Mine, east slope of Providence Mts., Mojave Desert, 1200 m. alt., May 21–24, 1920, *Munz, Johnston & Harwood 4275* (D, P, RM, UC); Rock Spring, May, 1876, *Palmer 526* (F, G, M); Cushenbury Canyon, San Bernardino Mts., 1680 m. alt., June 1, 1892, *Parish 2467* (NY); borders of Mojave Desert, Cushenbury, June 1, 1892, *Parish 2497* (F); Barstow, Mojave Desert, May 30, 1914, *Parish 9296* (D); in desert sand, Hesperia, May 4, 1917, *Spencer 413* (G, NY, P). RIVERSIDE CO.: dry soil, Coyote Holes, Little San Bernardino Mts., 1050 m. alt., May 6, 1922, *Munz & Johnston 5204* (P, UC). KERN CO.: rocky soil, south slope, Tehachapi Pass, Piute Range, 1200 m. alt., May 7, 1932, *Benson 3491* (UC); between Mojave and Cameron, May 16, 1905, *Brandegee* (UC); Randsburg, 1914, *Chittenden* (CA); valley below Cuddy's, Mt. Pinos Region, June 15, 1896, *Dudley & Lamb 4518* (D, UC); Inyokern, Mojave Desert, May, 1922, *Fitch* (P); Cuddy Canyon, 1350 m. alt., June, 1905, *Hall 6314* (UC); near Frazer Mt. Park, Santa Barbara National Forest, May 27, 1928, *Hilend* (UCLA); n. of Randsburg, Mojave Desert, May 12, 1927, *Jones* (P); Fort Tejon, Spring, 1876, *Kennedy* (F, G, PA TYPE); Red Rock Canyon, April 29, 1935, *McCracken* (CA); among shrubs of *Artemisia tridentata*, Cuddy Canyon, Mt. Pinos, 1350 m. alt., June 9, 1923, *Munz 6933* (P); dry soil, pine-sagebrush association, at head of Cuddy Valley, T. 9 N., R. 21 W., July 3, 1938, *Ownbey & Ownbey 1688* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS). LOS ANGELES CO.: Acton, May 9, 1926, *Atsatt* (UCLA); sloping hillsides, Manzana, Antelope Valley, May 9–24, 1896, *Davy 2480* (UC); 3½ mi. e. of Manzana, S. 21, T. 8 N., R. 16 W., 960 m. alt., May 14, 1935, *Gifford 715* (UC); Acton, 810 m. alt., May 25, 1893, *Hasse 1047* (NY); rocky ground, Mt. Soledad, s. of Mohave Station, May 5, 1920, *Johnston* (P); Ridge Route, June 7, 1926, *Jones* (D); gravel wash, Big Rock Creek, San Gabriel Mts., 1290 m. alt., May 26, 1923, *Munz 6818* (P). VENTURA CO.: near the Frazier Borax Mine, Mt. Pinos, 1560–1800 m. alt., June 12–14, 1908, *Abrams & McGregor 203* (D, G, NY); open, gravelly slope, w. of Lockwood Valley, 1500 m. alt., May 22, 1935, *Clokey & Anderson 6542* (Clokey); Griffins, Mt. Pinos, July, 1902, *Elmer 4175* (D); Cuddy Valley, Mt. Pinos, June 28, 1931, *Epling & Dunn* (UCLA); east slope, Mt. Pinos, 2100 m. alt., July, 1905, *Hall 6488* (UC); s. of Lebec, June 7, 1926, *Jones* (P).

SONORA. Rocky soil, Imuris, 825 m. alt., April 9, 1932, *Abrams 13185* (D); dry, rocky hills, 15 mi. n. of Magdalena, April 5, 1932, *Fosberg 7956* (D, P, UCLA).

40. Calochortus clavatus Watson in Proc. Am. Acad. **14**: 265. 1879.

Calochortus clavatus var. *avius* Jepson, Man. Fl. Pl. Calif. p. 235. 1923.

Bulb ovoid, with membranaceous coats; stem leafy, usually stout, zigzag, frequently branched, rarely bulbiferous; leaves broadly linear, attenuate, reduced upward; inflorescence 1–6-flowered, subumbellate, the outer bracts often exceeding the flowering pedicels; flowers large, erect, cup-shaped, lemon-yellow, sometimes with reddish brown markings on the sepals and a thin, transverse, zigzag line on each petal above the gland; sepals ordinarily much shorter than the petals, lanceolate, acute, glabrous; petals broadly obovate, cuneate, usually rounded and obtuse above, invested above the gland with a transverse band of distally enlarged, subclavate hairs; gland circular, deeply depressed, surrounded with a broad, deeply fringed membrane, densely covered with short, distally much-branched processes; anthers large, oblong, obtuse or acute, reddish or purplish brown, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit large, linear-lanceolate, acuminate, strongly 3-angled; immature seeds strongly flattened.

Well-developed plants of this species are the largest of the *Calochorti*. It is easily recognized by its yellow flowers and clavate hairs, but is otherwise quite variable. The variety *avius* is insufficiently known, but the single specimen examined is exactly matched by specimens from the Coast Ranges.

DISTRIBUTION. California: dry hills, southern Sierra Nevada, from Eldorado County to Mariposa County (according to Purdy), and in the South Coast Ranges from Stanislaus County southward to Los Angeles County.

CALIFORNIA. ELDORADO CO.: Pleasant Valley, *Purdy* (UC), type collection of *C. clavatus* var. *avius* Jepson. STANISLAUS CO.: lower part of Del Puerto Canyon, May 13, 1938, *Hoover 3415* (O). SAN BENITO CO.: Griswold Creek, April 29–May 1, 1921, *Abrams & Borthwick 7947* (D, NY, P, RM); loose soil in sandstone, *Pinus Sabiniana* belt, 2 mi. n. of Idria, San Carlos Range, 600 m. alt., May 25, 1938, *Constance & Morrison 2266* (O); near Idria, May 31, 1899, *Dudley* (D). SAN LUIS OBISPO CO.: summit, Cuesta, June 20, 1908, *Condit* (UC); California Polytechnic School Canyon, San Luis Obispo, June 7, 1910, *Condit* (UC); Cuesta, May 30, 1908, *Condit & Edwards* (UC); hills between Carisa and Cuyama, near the boundary between Santa Barbara and San Luis Obispo counties, June 13,

1902, *Eastwood* (G, NY); Arroyo Grande, June, 1895, *King* (UC); near San Luis Obispo, June, 1878, *Lemmon 1522* (F, G TYPE, M, UC); hills near San Luis Obispo, June, 1887, *Lemmon 4578* (G); exposed mountains, near San Luis Obispo, June, 1886, *Miles* (NY); Paso Robles, May 30, June, 1932, *Renner* (CA); summit, San Luis Mt., June 17, 1883, *Summers 841* (UC); Tunnel, San Luis Obispo, May 24, 1906, *Unangst* (UC). SANTA BARBARA CO.: Suey Creek, near Santa Maria, June 15, 1906, *Eastwood 594* (CA); on hills, Zaca Lake Forest Reserve, June 19-30, 1906, *Eastwood 521* (CA); Gaviota Canyon, near Santa Barbara, April 28, 1926, *Jones* (CA, P). SANTA CRUZ ISLAND: without exact locality, *Brandegee* (D). VENTURA CO.: South Mt., Santa Paula, May 31, 1908, *Abrams & McGregor 1* (D); Sulphur Mt. Spring, Sulphur Mts., 300–600 m. alt., June 1, 2, 1908, *Abrams & McGregor 3* (D); steep east slope in brush, Piru Creek, 3 mi. above Piru, April 7, 1932, *Fosberg 8169* (P, UCLA); Mt. Pinos, May 16, 1923, *Hart* (CA); Schuyler, Ridge Route, April 29, 1926, *Jones* (P); near Bardsdale, 180 m. alt., April 20, 1931, *McNab* (D); semi-shade, loam, near Bardsdale School, Bardsdale, Santa Clara Valley, 150 m. alt., May 14, 1931, *Wolf 2047* (D, P, UC, UCLA). LOS ANGELES CO.: Laurel Canyon, June 7, 1901, *Braunton 6* (D); openings in woods, north slope, Mandeville Canyon, Santa Monica Mts., 500 m. alt., May, 1929, *Clokey & Templeton 4552* (Clokey, F, M, NY, P, UC); Topanga Canyon, May 8, 18, 1926, *Epling* (UCLA); Topanga Canyon, May, 1927, *Epling* (UCLA); Los Alisos Canyon, Santa Monica Mts., May 9, 1931, *Epling* (CA, D, F, M, PA, UC, UCLA); open, sunny chaparral slope, near Summit, Ridge Route, 1500 m. alt., June 4, 1933, *Epling & Wheeler 1854* (D, M, UC, UCLA); Laurel Canyon, June 7, 1901, *Grant* (D); dry, heavy soil, south end of Ridge Road, May 15, 1922, *Pierce* (P); Castac Canyon, 9 mi. n. w. of Saugus, April 25, 1926, *Stanford* (P).

40a. Calochortus clavatus var. **gracilis** Ownbey, n. var.[40]

Smaller than the species in every way; stem slender; petals very sparsely bearded, usually with a narrow, zigzag, reddish brown line above the gland; gland small, scarcely depressed; anthers 4–7 mm. long, shorter than the filaments.

DISTRIBUTION. California: canyons, San Gabriel Mts., Los Angeles County.

CALIFORNIA. LOS ANGELES CO.: on dry slope, Bichota Canyon, North Fork of San Gabriel Canyon, June 28, 1930, *Crow* (P TYPE); San Antonio Canyon, May 15, 1910, *Davis 53* (M); San Gabriel Canyon, May 29, 1919, *Eastwood 9002* (CA); grassy slope, under oaks, mouth of Pico Canyon, near Newhall, 360 m. alt., May 17, 1930, *Ewan 5519* (RM); San Gabriel Canyon, June 25, 1904, *Grant* (D); canyons, Claremont, June, 1898, *Illingsworth 108* (P); San Francisquito Canyon, near Power Plant No. 1, June 12, 1922, *Moxley 1113* (RM); dry slope, Mint Canyon, n. of San Gabriel Mts., May 25, 1923, *Munz 6798* (NY, P); West Fork of San Gabriel Canyon, 675 m. alt., June 21, 1921, *Peirson 2468* (P).

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[40] **Calochortus clavatus** var. **gracilis** var. nov., minor omnino quam species; caule gracili; petalis parcissime barbatis plerumque supra glandulam linea angusta flexuosa rubro-fusca; glandula parva vix depressa; antheris 4–7 mm. longis filamentis brevioribus.

Subsection 8. GUNNISONIANI.[41]

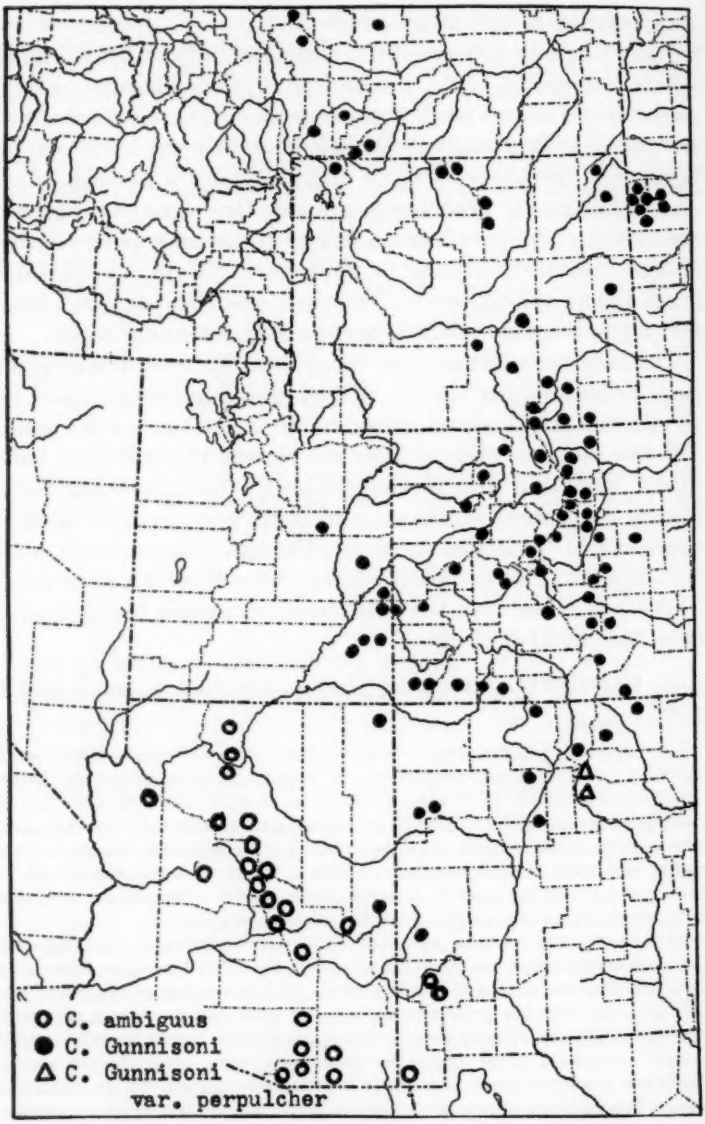
Inflorescences subumbellate; sepals usually shorter than the petals, lanceolate, acute to acuminate; petals obovate, cuneate, rounded and obtuse to abruptly short-acuminate, invested near the gland with distally branched, gland-tipped hairs; glands depressed, transversely more or less oblong, and densely covered with distally branched processes, the outermost of which are united at the base into a narrow, discontinuous membrane; anthers narrowly oblong to lanceolate, obtuse to apiculate; fruits linear-oblong, acute, 3-angled; seeds strongly flattened, with conspicuously inflated, hexagonally reticulate coats.

The GUNNISONIANI may be recognized by their transversely more or less oblong glands, narrow gland-membrane, and the distally branched, gland-tipped hairs on the face of the petals. The two species referred here are closely related. One has a Rocky Mountain distribution (Map 8), from western South Dakota to central Montana, and southward to New Mexico, westward to Utah and Arizona. The other is confined to the semi-desert regions of southwestern New Mexico and Arizona. Of these, *C. Gunnisoni,* the only one investigated, has a chromosome base number of nine.

41. Calochortus ambiguus (Jones) Ownbey, n. comb. and n. sp.[42]

[41] GUNNISONIANI subsect. nov., inflorescentiis subumbellatis; sepalis petalis plerumque brevioribus lanceolatis acutis vel acuminatis; petalis obovatis cuneatis rotundo-obtusis vel abrupte brevi-acuminatis, prope glandulam pilis apice ramosis glandulosisque; glandulis depressis transverse plus minusve oblongis, processis apice ramosis dense vestitis, processis extremis in membranam angustam interruptam basilariter coalitis; antheris anguste oblongis vel lanceolatis obtusis vel acutis vel apiculatis; capsulis lineari-oblongis acutis triangulatis; seminibus valde complanatis, testis insigniter inflatis hexagono-reticulatis.

[42] **Calochortus ambiguus** sp. nov., bulbo ovoideo membranaceo-tunicato; caule erecto plerumque simplici saepe bulbifero; foliis linearibus attenuatis superioribus reductis; inflorescentia 1–4-flora subumbellata; floribus erectis campanulatis roseolis aut caesiis, interdum prope basem sepalorum petalorumque obscure purpureis; sepalis petalis brevioribus lanceolatis acuminatis glabris; petalis obovatis cuneatis abrupte acuminatis, prope glandulam pilis fulvis apice ampliatis aut ramosis glandulosis praeditis; glandula depressa circulari vel transverse lunata, membrana angusta late fimbriata circumdata, processis brevibus apice ramosis dense vestitis; antheris oblongo-lanceolatis obtusis aut acutis roseolis filamentis basilariter dilatatis longioribus; ovario lineari non alato, stigmate persistente trifido; capsula lineari-oblonga acuta triangulata erecta; seminibus complanatis, testis insigniter inflatis hexagono-reticulatis.



Map 8. Distribution of the species and variety of the subsection GUNNISONIANI.

Calochortus Watsoni var. *ambiguus* Jones, Contrib. West. Bot. No. 14, p. 27. 1912.

Bulb ovoid, with membranaceous coats; stem erect, usually unbranched, often bulbiferous; leaves linear, attenuate, reduced upward; inflorescence 1–4-flowered, subumbellate; flowers erect, campanulate, pinkish or bluish gray, sometimes marked with dull purple near the base of the sepals and petals; sepals shorter than the petals, lanceolate, acuminate, glabrous; petals obovate, cuneate, abruptly acuminate, invested near the gland with yellowish, distally enlarged or branched, gland-tipped hairs; gland depressed, circular to transversely lunate, surrounded with a narrow, deeply fringed membrane, and densely covered with short, distally branched processes; anthers oblong-lanceolate, obtuse or acute, pinkish, longer than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute, 3-angled, erect; seeds flattened, with conspicuously inflated, hexagonally netted coats.

This species is most closely allied to *C. Gunnisoni,* from which it differs in its shorter gland and usually obtuse anthers. It is more likely to be confused with certain phases of *C. Nuttallii,* but the gland-tipped hairs on the petals and the fungoid gland-processes readily distinguish it.

DISTRIBUTION. In dry soil, southwestern New Mexico, northwestward across Arizona to the region of the Grand Canyon.

NEW MEXICO. GRANT CO.: Silver City, 1911, *Beard* (M); Silver City, May 4, 1919, *Eastwood 8416* (CA, G); Gila River, near Silver City, May 4, 1930, *Jones 25930* (M, P); Mangas Springs, 18 mi. n. w. of Silver City, 1455 m. alt., May 9, 1903, *Metcalfe 55* (D, G, M, NY, P, RM, UC). HIDALGO CO.: dry, rocky places, San Luis Mts., Canyon of Guadaloupe, April 25, *Smith* (NY).

ARIZONA. COCHISE CO.: Dragoon Mts., June, 1899, *Eby* (M); high mountains, Lowell, May 14, 1884, *Parish 252* (G). NAVAJO CO.: Fort Apache, May, 1893, *Hoyt* (NY); Fort Apache, 1903, *Mayerhoff 112* (F). GILA CO.: 2 mi. n. w. of Pine, May 19, 1937, *Cutler 1108* (M); on road to Amethyst Mine, Mazatzal Mts., Apache Trail Region, May 11, 1929, *Eastwood 17087* (CA, F, NY); Sierra Ancha, Apache Trail Region, May 17, 1929, *Eastwood 17304* (CA); same locality, May 27, 1929, *Eastwood 17549* (CA); Pinal, May 26, 1890, *Jones* (P); Apache Trail, near Roosevelt, May 5, 1929, *McKelvey* (CA); near Pine, where road turns off to Natural Bridge, May 11, 1931, *McKelvey 2150* (G). PIMA CO.: between Sonoita and Vail, May 4, 1931, *McKelvey 2107* (G, P); foothills, Santa Catalina Mts., April 26, 1930, *Peebles 6864* (NY); Tucson to Redington, 1140 m. alt., April 27, 1935, *Peebles 11323* (P); Santa Catalina Mts., May 11, 1883, *Pringle* (F, G, NY,

PA); Santa Rita Mts., 1500 m. alt., May 17, 1884, *Pringle* (F, PA). SANTA CRUZ CO.: Ruby, 1260 m. alt., May 4, 1935, *Peebles & Fulton 11436* (F); near Sonoita, May 6, 1930, *Peebles & Harrison 7073A* (CA). COCONINO CO.: Grand View, Grand Canyon of the Colorado River, June 17, 1916, *Eastwood 5791* (CA); on plateau above Oak Creek Canyon, 17 mi. s. of Flagstaff, 2100 m. alt., June 14, 1927, *Goddard 559* (UC); Cape Royal, Kaibab Forest, near rim of Grand Canyon, 2400 m. alt., July 17, 1930, *Goodman & Hitchcock 1650* (CA, D, M, NY, PA, UC, UM); rocky hillside, Flagstaff, 2100 m. alt., June 29, 1922, *Hanson A22A* (F, M, NY); Jacobs Pool, Kaibab Forest, July, 1926, *Jaeger* (P); Flagstaff, Aug. 5, 1884, *Jones* (D, NY, P TYPE); Flagstaff, Aug. 7, 1884, *Jones 48* (G); San Francisco Mts., June 4, 1890, *Jones* (P); Bright Angel, Grand Canyon, July 22, 1920, *Jones* (P); Grand Canyon, July 9, 1925, *Jones* (P); Williams, June 14, 1929, *Jones* (P); Williams, June 15, 1930, *Jones 25183* (D, M, P, UM); Toll Road, San Francisco Mts., 2400–2700 m. alt., July 28, 1935, *Kearney & Peebles 12182* (NY); Grand Canyon of the Colorado, 2100 m. alt., June 26, 1898, *MacDougal 164* (F, G, NY, PA, RM, UC); woods, Kaibab Plateau, n. of Jacob Lake, July 14, 1929, *Mathias 662* (M); Baker Butte, Mogollon Mts., July 31, 1887, *Mearns 108* (NY); plains, near Flagstaff, May–Oct., 1900, *Purpus 8017* (UC). YAVAPAI CO.: Fort Whipple, 1865, *Coues & Palmer* (M); Prescott, May 22, 1919, *Eastwood 8837* (CA); Fort Verde, Aug., 1887, *Mearns* (NY); Ashfork, May, 1883, *Rusby* (F, NY, PA); 2 mi. n. w. of Prescott, 1500 m. alt., April 25, 1934, *Stone 91* (NY); Prescott, via Juniper, to Seligman, 15 mi. n. w. of Prescott, 1650 m. alt., April 26, 1934, *Stone 93* (NY). MARICOPA CO.: near Ashdale, 1230 m. alt., May 18, 1935, *Peebles 11638* (NY). MOHAVE CO.: Peach Springs, July, 1884, *Lemmon & Lemmon* (UC).

42. Calochortus Gunnisoni Watson, Bot. U. S. Geol. Expl. 40th Par. [Bot. King's Exped.] p. 348. 1871.

Calochortus venustus var. *?* Torrey & Gray in Rept. U. S. Pac. R. R. Surv. **2** [Bot. Beckwith's Rept. p. 130]. 1855.

Calochortus Gunnisoni var. *Kreglagi* Regel in Gartenflora **23**: 129, *t. 793*. 1874.

Calochortus Gunnisoni var. *maculatus* Cockerell in West. Am. Sci. **5**: 17. 1888 (misprinted *imaculatus*); **6**: 135. 1889.

Calochortus Gunnisoni var. *immaculatus* Cockerell, *l. c.* **5**: 17. 1888.

Calochortus Gunnisoni var. *purus* Cockerell, *l. c.*

Bulb ovoid, with membranaceous coats; stem erect, unbranched, rarely bulbiferous; leaves linear, reduced upward; inflorescence 1–3-flowered, subumbellate; flowers erect, campanulate, white to purple, greenish within, often with a narrow, transverse, purple band on each petal above the gland and a purple spot on the claw, sepals similarly marked; sepals

usually much shorter than the petals, lanceolate, acute, glabrous; petals obovate, cuneate, usually obtuse and rounded above, densely bearded about the gland with distally branched, gland-tipped hairs; gland depressed, transversely oblong, more or less arched, densely covered with distally branched processes, the outermost of which are somewhat united at the base to form a discontinuous membrane; anthers lanceolate, acute to apiculate, longer than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute, 3-angled, erect; seeds flattened, with conspicuously inflated, hexagonally netted coats.

The longer gland and acute anthers separate this species from *C. ambiguus*, the only species to which it is closely allied.

DISTRIBUTION. Hills and mountains, western South Dakota to central Montana, southward through Wyoming, Colorado, eastern Utah and northeastern Arizona to central New Mexico.

SOUTH DAKOTA. MEADE CO.: open limestone slopes, Tilford, July 9, 1924, *McIntosh 464* (RM); Piedmont, July, 1895, *Pratt* (P, WS). LAWRENCE CO.: Black Hills, near Spearfish, 1200 m. alt., July 23, 1924, *Ballow* (D); meadow and open woods, yellow pine association, Limestone District, Crooks Tower, Black Hills, Aug. 5, 1927, *Hayward 2745* (F, RM); old open burn, limestone, rim of Spearfish Canyon, near Savoy, 1680 m. alt., June 29, 1910, *Murdoch 4182* (D, F, G); Whitewood, 1350 m. alt., July 7, 1892, *Rydberg 1046* (G, NY). PENNINGTON CO.: open grassland, Reynolds Prairie, 3 mi. n. e. of Deerfield, July 23, 1927, *Hayward 2341* (F, RM).

MONTANA. FERGUS CO.: near Judith Mts., Aug., 1860, *Hayden* (M). SWEET GRASS CO.: Greycliff, 1200 m. alt., June, 1913, *Marsh 9870* (G, NY). CARBON CO.: Red Lodge, July 10, 1905, *Draper* (UC); Rock Creek Canyon, Beartooth Mts., Custer National Forest, 1800 m. alt., July 27, 1937, *Williams & Williams 3726* (G, M, NY). CASCADE CO.: Belt Mts., July 22, 1886, *Anderson 404* (UM); 5 mi. from Barker, Little Belt Mts., 1800 m. alt., Aug. 17, 1896, *Flodman 348* (M, NY). MEAGHER CO.: rocky soil, in old burn, Nevada Creek, S. 13, T. 10 N., R. 11 E., Jefferson National Forest, 1560 m. alt., Aug. 25, 1927, *Park 57* (UM). PARK CO.: Livingston, 1901, *Scheuber 244* (NY).

WYOMING. CROOK CO.: foothills, Inyan Kara Creek, Black Hills, 1927, *Hayward 2112* (F); sandy soil under pines, 7 mi. n. w. of Hulett, July 13, 1938, *Ownbey 481* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS). NIOBRARA CO.: along creek, Hat Creek, June 30, 1938, *Cutler 2467* (O). LARAMIE CO.: Granite Canyon, July 31, 1930, *Fuller* (M). ALBANY CO.: Laramie Hills, July, 1892, *Buffum* (RM); hillside, Laramie-Fort Collins Highway, near State Line, July 17, 1937, *Detling 2310* (UO); Chimney Rock, Sand Creek, July 29, 1929, *Greenman & Greenman 6044* (M); University of Wyoming Summer Camp, Medicine Bow Mts., 2880 m. alt., Aug. 1, 1929, *Greenman & Greenman 6077* (M); moist,

grassy gulch or slope, Rock River, 2100 m. alt., July 19, 1914, *Macbride 2836* (RM); Sybille Hills, July 8, 1894, *Nelson 319* (G, RM); Cummins, July 27, 1895, *Nelson 1451* (M, NY, RM); moist meadows, South Sybille, July 3, 1900, *Nelson 7389* (G, M, NY, P, RM, UO); among the underbrush, wet bottoms, Centennial, July 26, 1900, *Nelson 7685* (Clokey, D, RM); dry gulch, west slope of Sheep Mt., July 3, 1934, *Ownbey 217* (O); near the edges of moist thickets and meadows, Medicine Bow Range, 3300 m. alt., July, 1936, *Sella* (F). SHERIDAN CO.: open slope, near South Fork Inn, Big Horn National Forest, July 17, 1933, *Benner 5036* (PA); headwaters of Tongue River, Big Horn Mts., July, 1898, *Tweedy 61, 62, 63* (NY); Big Horn, 1800 m. alt., July, 1899, *Tweedy 2559* (NY). BIG HORN CO.: dry south slope of Medicine Mt., Big Horn Mts., 2550 m. alt., July 6, 1936, *Williams & Williams 3257* (G, M, NY, WS). JOHNSON CO.: creek bottoms, Cañon Creek, July 27, 1901, *Goodding 405* (G, M, NY, RM); eastern slope of the Big Horn Mts., headwaters of Clear Creek and Crazy Woman River, 2100–2700 m. alt., July 20–Aug. 15, 1900, *Tweedy 3515* (NY, RM). NATRONA CO.: Casper, July 13, 1893, *Evermann* (D). CARBON CO.: Freezeout Hills, July 10, 1898, *Nelson 4500* (P, RM); Indian Grove Mts., July 17, 1898, *Nelson 4897* (RM). YELLOWSTONE NATIONAL PARK: Soda Butte, Aug. 22, 1922, *Hawkins 937* (UCLA); open woods, Elk Fork, 2100 m. alt., Aug. 15, 1928, *Smith 158* (WS).

COLORADO. LARIMER CO.: Longs Peak Inn, Estes Park, 2850 m. alt., Aug. 11, 1933, *Allen 136* (M); arid plains, 10 mi. n. of Fort Collins, June 21, 1933, *Applegate 8626* (D); Estes Park, 2400 m. alt., Aug., 1933, *Burton* (M); at the "Forks," Thompson River, Estes Park, July 11, 1912, *Churchill* (G); Estes Park, 1904, *Cooper 279* (RM); hillsides, foothills, 1950 m. alt., June 17, 1895, *Cowen* (WS); Horsetooth Gulch, July 15, 1897, *Crandall 2474* (RM, UC); above the Brinwood, Rocky Mt. National Park, Aug. 2, 1933, *Nelson & Nelson 876* (D, M, RM); Horsetooth, July 16, 1895, *Osterhout 837* (RM); grassy slope, 3 mi. n. of Estes Park, Rocky Mt. National Park, 2550 m. alt., Aug. 4, 1937, *Rollins 1883* (O); slopes of Deer Mt., Aug. 13, 1927, *Woodson 1836* (M). BOULDER CO.: dry soil, Eldorado Springs, 1590 m. alt., June 24, 1917, *Clokey 2763* (Clokey, NY); mesa fronting Flagstaff Hill, Boulder, 1710 m. alt., June 18, 1906, *Daniels 53* (M); mesa slopes, Boulder, 1680 m. alt., June 23, 1921, *Hanson C323* (M); Sugar Loaf Mt., July 21, 1906, *Robbins 2210* (RM); Eldora, July 27, 1906, *Robbins 2322* (RM); Boulder, June 23, 1913, *Vestal* (D, M). JEFFERSON CO: vicinity of Conifer, 1950 m. alt., July, 1934, *Cletus 245* (F); mountain top, Lookout Mt., 2190 m. alt., July 25, 1917, *Clokey 2864* (CA, Clokey, F, RM, UC); near Mt. Morrison, 1830 m. alt., June 24, 1937, *Constance & Rollins 1919* (M, O, UC, WS); Morrison, *Eastwood* (UC); foothills, near Golden, June 20, 1878, *Jones 249* (P); Morrison, June 24, 1913, *Jones* (PA); South Table Mt., Golden, June 17, 1896, *Knowlton 81* (G); Morrison, June 19, 1881, *Smith* (PA); Morrison, June 18, 1891, *Smith* (M). GILPIN CO.: open aspen woods, Tolland, 2730 m. alt., Aug. 2, 1919, *Munz 2991* (P); Eldora to Baltimore, 2550–2850 m. alt., June 20–July 10, 1903, *Tweedy 5510* (NY, RM). CLEAR CREEK CO.: meadows, near Empire City, July 17, 1881, *Engelmann* (M); dry mountain sides, vicinity of Georgetown, June 28–Aug. 7, 1875, *Patterson* (F); vicinity of Georgetown, July 11–Aug. 11, 1876, *Patterson* (F). PARK CO.: Como, South Park, 2932 m. alt., Aug. 3, 1895, *Cowen* (NY); mountains, South Park, July 26, Aug. 7, 1892, *Hughes 64* (G). ELBERT CO.: grassy park, 12 mi. e. of Kiowa, June 22, 1937, *Ownbey 1294* (M, O). DOUGLAS CO.: 5 mi. w. of Sedalia, 1800 m. alt., June 23, 1937, *Snyder & Beetle 52* (RM).

EL PASO CO.: Colorado Springs, June 29, 1926, *Benke 4195* (CA, F); Ruxton Creek, region of Pikes Peak, 2850 m. alt., Aug. 3, 1912, *Brumback & Davies 22* (F); Dark Canyon, 2900 m. alt., July 25, 1901, *Clements & Clements 204* (D, G, NY, RM); Ruxton Dell, 2950 m. alt., July 27, 1901, *Clements & Clements 347* (D, G, M, NY, RM); grassy clearing in the brush, Manitou end of Ute Pass Trail, Pikes Peak Region, 2055 m. alt., July 27, 1920, *Johnston 2399* (UC); moist soil along creek, Pikes Peak Auto Highway, 2700 m. alt., Aug. 10, 1935, *Ownbey 939* (O, RM); Colorado Springs, July 16, 1872, *Porter* (PA); Pikes Peak, 1904–1906, *Schedin & Schedin 286* (RM); Ute Pass, Aug. 15, 1904, *Taylor* (PA); loam soil, Pikes Peak Road, 2700 m. alt., Aug. 11, 1935, *Williams 2475* (G, M, UC, WS); Colorado Springs, *Williamson* (PA). TELLER CO.: Cripple Creek, July, *Schedin & Schedin 264* (RM). FREMONT CO.: Cañon City, 1620 m. alt., June, 1877, *Brandegee* (UC). CUSTER CO.: Wet Mt. Valley, July 24, 1872, *Redfield* (M). PUEBLO CO.: Beulah, Aug., 1887, *Reed* (F). HUERFANO CO.: Veta Pass, 2400–2700 m. alt., July 3, 1900, *Rydberg & Vreeland 6434* (NY, RM); meadow, La Veta, July 14, 1896, *Shear 3560* (NY, RM); La Veta, July 14, 1896, *Shear 3641* (NY). LAS ANIMAS CO.: Trinidad, 1800–2100 m. alt., Aug., 1912, *Beckwith* (CA); steep slope among oak brush, 1 mi. s. of Morley, Trinidad to Raton, 2250 m. alt., July 4, 1937, *Rollins 1813* (G); dry hillside, north slope of Raton Mesa, near the head of San Francisco Canyon, 2400 m. alt., July 11, 1937, *Rollins 1853* (NY, O). JACKSON CO.: dry table-land, North Park, near Teller, 2400 m. alt., Aug. 4, 1884, *Sheldon 25* (F, NY, PA, UC). GRAND CO.: near Hot Sulphur Springs, Middle Park, 2280 m. alt., Aug. 3–8, 1907, *Ramaley & Robbins 3564* (RM, UC). LAKE CO.: Leadville, 1889, *Bailey* (UCLA); dry hillside near the Arkansas River, 1 mi. s. of Fremont Pass, Leadville to Dillon, 3300 m. alt., July 15, 1936, *Rollins 1393* (G, NY); near Leadville, Aug., *Schedin & Schedin 265* (RM); near Leadville, *Schedin & Schedin 285* (RM); Leadville, July 9, 1886, ex herb. *Trelease* (M). CHAFFEE CO.: Buena Vista, 2250 m. alt., July, 1886, ex herb. *Harper* (UC); Clear Creek, July 13, 1889, *Keller* (PA); gravelly slope, Buena Vista, 2460 m. alt., July 13, 1892, *Sheldon* (Clokey). GUNNISON CO.: Jacks Cabin, region of the Gunnison Watershed, 2484 m. alt., July 26, 1901, *Baker 609* (G, NY, P); Crested Butte, *Eastwood* (UC). SAGUACHE CO.: Steele Canyon, Villa Grove, July 23, 1896, *Shear 5107* (NY). ARCHULETA CO.: Piedra, July 9, 1899, *Baker 252* (F, G, M, NY, P, RM); Pagosa Springs, 2100 m. alt., July 18, 1893, *Smith* (PA). ROUTT CO.: Steamboat Springs, July, 1891, *Eastwood* (D, UC); mesa, Williams Fork, July 24, 1903, *Sturgis* (G). RIO BLANCO CO.: North Elk Canyon, July 28, 1902, *Sturgis* (CA, G, NY). GARFIELD CO.: Glenwood Springs, July 1, 1895, *Osterhout 838* (RM). DELTA CO.: hills, Surface Creek, Grand Mesa, 2520 m. alt., June, 1892, *Purpus 60* (F). MONTROSE CO.: open aspen grove, Tabeguache Basin, 2400 m. alt., July 29, 1914, *Payson 546* (F, G, M, RM); dry foothills, Paradox, 1950 m. alt., July 10, 1912, *Walker 213* (G, RM). LA PLATA CO.: Florida River, 7 mi. n. of Florida, July 29, 1933, *Alexander 151* (UC). MONTEZUMA CO.: sage plains, Mancos, June 22–July 8, 1898, *Baker, Earle & Tracy 1125, in part* (F, M, NY, P); entrance to Mesa Verde National Park, 2100 m. alt., June 29, 1930, *Goodman & Hitchcock 1355* (CA, D, M, NY, PA, UC, UM); Mesa Verde National Park, June 29, 1935, *Zobel* (M).

NEW MEXICO. COLFAX CO.: low uplands, vicinity of Raton, 1980 m. alt., July, 1895, *St. John 25* (G); Cimarron Canyon, July 8, 1937, *Schwarz & Talley* (M). TAOS CO.: more than a mile above the recreation area, La Junta Canyon, July 22, 1936, *Marcelline 2146* (F). RIO ARRIBA CO.: 3 mi. n. of Chama, 2355 m. alt.,

July 24, 1928, *Wolf 2966* (CA, D, G). SANDOVAL CO.: vicinity of Sulphur Springs, 2500 m. alt., Aug. 17, 1926, *Arsène & Benedict 16459* (F); among bushes, Balsam Park, Sandia Mts., 2460 m. alt., July, Aug., 1914, *Ellis 238* (M, NY). MCKINLEY CO.: Gallup to Zuñi, July 19, 1932, *Hawver* (CA); Fort Wingate, 2100 m. alt., July, 1874, *Rothrock 148* (F). CATRON CO.: Mogollon Mts., near the West Fork of the Gila River, 2550 m. alt., Aug. 14, 1903, *Metcalfe 494* (D, G, M, NY, P, RM, UC).

UTAH. CARBON CO.: Sunnyside, 2100 m. alt., 1905, *Jones* (P). GRAND CO.: ridge w. of head of Post Canyon, Book Cliffs, 2400 m. alt., July 27, 1935, *Graham 9832* (F, G, M); slopes, La Sal Mts., 3150 m. alt., July 31, 1924, *Payson & Payson 4085* (RM). SAN JUAN CO.: vicinity of La Sal Ranger Station, La Sal Mts., 2100 m. alt., July 2, 1932, *Maguire & Redd 1705* (M); western slope of La Sal Mts., 2200–3000 m. alt., July 6, 1911, *Rydberg & Garrett 8603* (NY); meadow, s. of Monticello, 2100 m. alt., July 24, 1911, *Rydberg & Garrett 9145* (NY); south side of Abajo Mts., 2000–2500 m. alt., July 28, 29, 1911, *Rydberg & Garrett 9239* (NY); Hammond Canyon, Elk Mts., 1800 m. alt., Aug. 10, 1911, *Rydberg & Garrett 9580* (NY). COUNTY NOT DETERMINED: without locality, Gunnison's Expedition (NY TYPE).

ARIZONA. APACHE CO.: Keet Seel Canyon, Navajo Reservation, 1950–2250 m. alt., June 17, 1933, *Darsie* (UCLA); 12 mi. e. of Big Lake, Apache National Forest, Aug. 2, 1938, *Hitchcock, Rethke & Van Raadshooven 4493* (O, WS).

42a. Calochortus Gunnisoni var. **perpulcher** Cockerell in Bot. Gaz. **29**: 281. 1900.

Petals pale yellow; otherwise as in the species.

Hardly more than a color form, but locally constant, and easily recognized.

DISTRIBUTION. New Mexico: in the mountains of western Mora and San Miguel counties.

NEW MEXICO. MORA CO.: Horsethief Meadow, Santa Fe Forest, 3000 m. alt., Aug. 15, 1923, *Eggleston 19032* (NY). SAN MIGUEL CO.: Hermits Peak, Aug., *Snow* (UC); Round Mt., Pecos River National Forest, 2700 m. alt., July 11 1908, *Standley 4268* (M, NY, RM). COUNTY NOT DETERMINED: Pecos River Forest Reserve, July 19, 1898, *Coghill 78* (M).

Section III. CYCLOBOTHRA

CYCLOBOTHRA [D. Don in] Sweet, Brit. Fl. Gard. **3**: *t. 273.* 1828, as genus; Baker in Journ. Linn. Soc. Lond. **14**: 307. 1874; Painter in Contrib. U. S. Nat. Herb. **13**: 343. 1911, as subgenus; Baker ex Watson in Proc. Am. Acad. **14**: 267. 1879, as section.

Bulbs ovoid, with fibrous-reticulate coats; stems usually branched, often bulbiferous in the axils of the upper leaves and bracts; basal leaves usually conspicuous, the cauline ones

lanceolate to linear, successively reduced upward; inflorescences usually 2-flowered, the flowers narrowly to broadly campanulate, erect or nodding; sepals obovate to narrowly lanceolate, obtuse to attenuate, glabrous to sparsely hairy, sometimes with a gland like those on the petals; petals spatulate to broadly obovate, obtuse or acute, usually more or less conspicuously bearded on the inner face; glands oblong to circular, occasionally absent or represented by only a glandular blotch, surface naked or nearly so, rarely depressed; anthers oblong to lanceolate, obtuse to short-apiculate; ovaries linear, not winged, tapering to a persistent, trifid stigma; fruits lanceolate to linear, 3-angled, erect or nodding; seeds irregular or flattened, usually with minutely reticulate coats. (Spp. 43–57).

TYPE SPECIES: **Calochortus barbatus** (HBK.) Painter.

The section CYCLOBOTHRA includes those species with fibrous-reticulate bulb-coats and elongate, 3-angled capsules. The glands are usually entirely naked, and are never as densely covered with processes as in the other two sections. The basal leaves are conspicuous, but usually not so much so as those of the section EUCALOCHORTUS. Nine is the haploid number of chromosomes in *C. Plummerae,* the only species which has been cytologically investigated.

The species of the section CYCLOBOTHRA are quite different in their morphology, and are easily separated into four, well-marked subsections. From both geographical and morphological evidence, these seem to represent four separate lines of development within the section. One of these, the WEEDIANI, closely resembles the section MARIPOSA in habit, particularly in its large, erect flowers. Another, the PURPUREI, shows a striking superficial resemblance to the genus *Fritillaria,* as do also the BARBATI, to a lesser degree.

In distribution, the section is entirely southern. Three of the species, comprising the subsection WEEDIANI, are confined to southern California and northern Lower California. The remainder are found from southern Chihuahua southward to Guatemala, entirely south of any other species of the genus. From this evidence, it would seem that there have been two centers of development and dispersal within the section CYCLO-

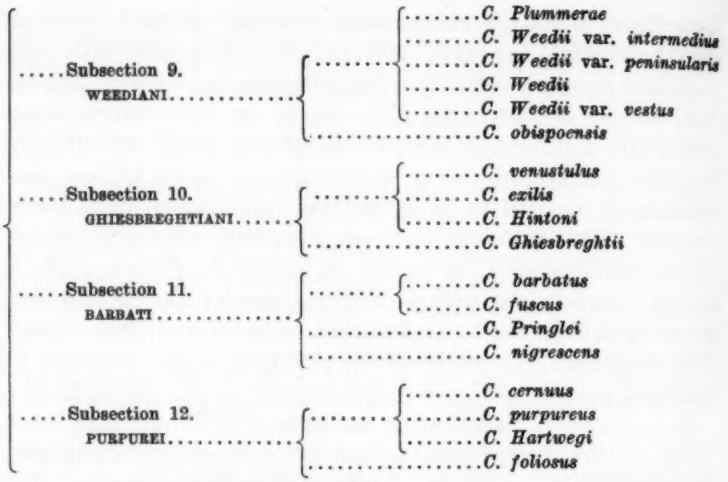


Fig. 3. Diagram showing morphological relationships of the subsections, species and varieties of the section CYCLOBOTHRA.

BOTHRA, the first in southern California, and the second on the Mexican Plateau. It is probable that the section originated in one of these areas and that the other represents an early migration, but there is little evidence on this point.

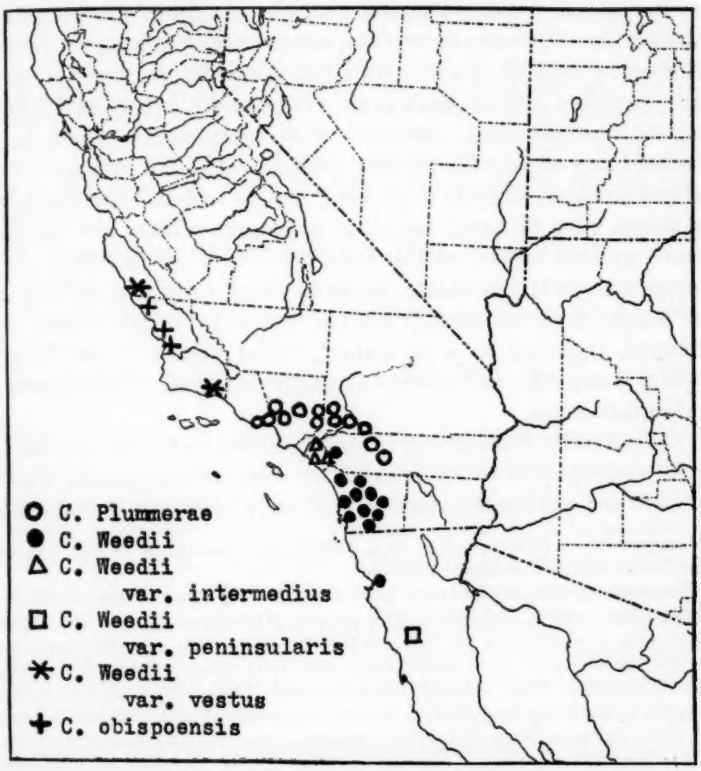
Subsection 9. WEEDIANI.[43]

Stems slender, tall, usually branched, not bulbiferous; flowers erect; petals conspicuously bearded; glands slightly depressed, surrounded by a dense ring of more or less united, hair-like processes; fruits linear, 3-angled, erect.

The WEEDIANI are distinguished by their erect flowers, densely bearded petals, characteristic glands and non bulbiferous stems. The three species referred here form an alliance somewhat apart from the remainder of the section CYCLOBOTHRA on both morphological and geographical grounds. Superficially, two of the species, *C. Weedii* and *C. Plummerae*, resemble the section MARIPOSA, with which they have been

[43] WEEDIANI subsect. nov., caulibus gracilibus altis plerumque ramosis non bulbiferis; floribus erectis; petalis insigniter barbatis; glandulis subdepressis, annulo denso processorum filiformium plus minusve coalitorum circumdatis; capsulis linearibus triangulatis erectis.

placed, but their natural affinities are entirely with the section CYCLOBOTHRA. The third species, *C. obispoensis,* although closely related, is quite unlike any other species of the genus. This subsection is limited in its distribution to southern California and northern Lower California (Map 9).



Map 9. Distribution of the species and varieties of the subsection WEEDIANI.

43. Calochortus Plummerae Greene, Pittonia **2**: 70. 1890.

Calochortus Weedii var. *purpurascens* Watson in Proc. Am. Acad. **14**: 265. 1879, in part.

Calochortus Weedii var. *albus* Hort. acc. Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 133. 1901, as synonym.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, tall, usually branched, not bulbiferous; basal leaf broad and long, usually withering before anthesis; cauline leaves linear, attenuate, becoming involute, reduced upward; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers broadly campanulate, erect, the petals pale pink to deep rose-colored, drying purplish; sepals equalling or exceeding the petals, narrowly lanceolate, acuminate, glabrous or with a few hairs near the base; petals broadly obovate, cuneate, usually rounded and erose-dentate above, very rarely at all fimbriate, conspicuously bearded with long, yellow hairs in a broad band across the middle, glabrous distally or nearly so; gland circular, slightly depressed, nearly naked, bordered with a dense ring of long, hair-like processes which are usually more or less united at the base into fascicles; anthers very large, narrowly lanceolate, acute to short-apiculate, as long as or longer than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, acute, 3-angled, erect; seeds strongly flattened, with minutely reticulate coats.

Calochortus Plummerae is closely allied to *C. Weedii,* but is easily recognized by its pinkish or rose-colored petals, which are not bearded to the apex and are only very rarely fimbriate.

DISTRIBUTION. California: on dry, rocky slopes, mountains of Los Angeles, San Bernardino and Riverside counties.

CALIFORNIA. LOS ANGELES CO.: Lone Pine Canyon, desert slopes of the San Gabriel Mts., 1050 m. alt., July 5, 1908, *Abrams & McGregor 681* (D, NY); mountains, near Newhall, June 25, 1897, *Barber 176* (UC); hills, near Sherman, June 5, 1901, *Braunton 131* (D); brushy ridge, Mandeville Canyon, Santa Monica Mts., 350 m. alt., June, 1929, *Clokey & Templeton 4579* (Clokey, F, G, M, NY, P, RM, UC, UM); Garvanza, May 27–June 10, 1906, *Eastwood 58* (CA); Claremont, June 15, 1928, *Eastwood 15408* (CA, UC); Pasadena, June 17, 1904, *Grant 126* (F, PA, RM); head of Long Canyon, San Gabriel Mts., 1275 m. alt., June 20, 1910, *Grinnell* (D); Live Oak Canyon, Claremont, 360 m. alt., June 10, 1897, *Hill 10342* (P); Claremont, June 2, 1926, *Jones* (CA, D, NY); dry hillside, in chaparral, Verdugo Canyon, near Los Angeles, June 22, 1915, *Macbride & Payson 762* (G, RM); Base Line Road, Claremont, June 10, 1919, *Munz 3274* (P); rocky hillside, mouth of Los Alisos Canyon, Santa Monica Mts., June 27, 1938, *Ownbey & Ownbey 1666* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); trail between Camp Coldbrook and Pine Flats, San Gabriel Mts., July 11, 1930, *West, Sweet & Crow* (P). SAN BERNARDINO CO.: Yucaipa Valley, June 18,

1902, *Berry* (D); Cajon Pass, 1860–1861, *Cooper* (G, type of *C. Weedii* var. *purpurascens* Watson); Cajon Pass, San Gabriel Mts., May 16, 1931, *Epling, Dunn & Goen* (CA, D, F, M, NY, UCLA); Lower Mill Creek Canyon, San Bernardino Mts., June 10, 1897, *Hall 631* (UC); Cajon Pass, San Antonio Mts., 1050 m. alt., June 1–3, 1900, *Hall 1417* (UC), *1480* (D); in chaparral, City Creek Road, below "Inspiration Point," San Bernardino Mts., 1500 m. alt., July 10, 1927, *Howell 2770* (CA); Cajon Canyon, June, 1928, *Jones* (G, P, WS); dry, rocky soil, among shrubs, Cajon Canyon, San Bernardino Mts., June 30, 1938, *Ownbey & Ownbey 1681* (G, Kew, M, O, UC); vicinity of San Bernardino, 300–450 m. alt., May, 1895, *Parish* (NY); dry mesas, San Bernardino Valley, near San Bernardino, 300 m. alt., June 8, 1917, *Parish 11333* (UC); Forest Home, San Bernardino Mts., 1590 m. alt., July, 1928, *Van Dyke* (CA); Mill Creek, San Bernardino Mts., 900 m. alt., June, 1903, *Williamson* (PA). RIVERSIDE CO.: lower canyons and slopes, San Jacinto Mts., 600 m. alt., June 21, 1910, *Condit* (UC); canyon of the San Jacinto River, San Jacinto Mts., 750 m. alt., June, 1901, *Hall 2015* (UC); near Banning, June 20, 1926, *Jones* (CA, D, NY, P); head of Banning Canyon, July 16, 1915, *Seitz* (CA).

44. Calochortus Weedii Wood in Proc. Acad. Philad. [**20**]: 169. 1868.

Calochortus luteus var. *Weedii* Baker in Journ. Linn. Soc. Lond. Bot. **14**: 309. 1874.

Calochortus citrinus Baker in Bot. Mag. Ser. III. **31**: *t. 6200*. 1875.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, tall, usually branched, not bulbiferous; basal leaf broad and long, usually withering before anthesis; cauline leaves linear, attenuate, becoming involute, reduced upward; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers broadly campanulate, erect, the petals orange-yellow, minutely flecked and often margined with reddish brown; sepals equalling or exceeding the petals, narrowly lanceolate, attenuate, glabrous or with a few hairs near the base; petals broadly obovate, cuneate, usually rounded above, with the margin minutely dentate to conspicuously fimbriate, conspicuously bearded on the inner face nearly or quite to the apex with long, yellow hairs; gland circular, slightly depressed, nearly naked, bordered with a dense ring of long, hair-like processes which are often united at the base into a more or less continuous membrane; anthers very large, narrowly oblong-lanceolate, acute to short-acuminate, about as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent,

trifid stigma; fruit linear, acute, 3-angled, erect; seeds strongly flattened, with minutely reticulate coats.

Calochortus Weedii may be distinguished from *C. Plummerae*, its nearest ally, by its yellow flowers, usually fimbriate petals and different geographical range. It is very variable.

DISTRIBUTION. Dry, rocky hills, southern California, in western Riverside and San Diego counties, southward to northern Lower California.

CALIFORNIA. RIVERSIDE CO.: dry, sandy places, Temescal, June 9, 1895, *Hall* (UC); Santiago Peak Trail, Santa Ana Mts., May 30, 1931, *Howell 6586* (CA); dry slopes, trail from Glen Ivy to Santiago Peak, Santa Ana Mts., 900 m. alt., June 14, 1923, *Munz 7104* (P, UC). SAN DIEGO CO.: Mission Hills, San Diego, June 17, 1903, *Abrams 3752* (D, G, M, NY, PA); dry ridges, between Ramona and Ballena, June 19, 1903, *Abrams 3774* (D, G, M, NY, P, PA); Quince Street, between First and Front, San Diego, June 10–25, 1906, *Brandegee* (D, UC); Capitan School House, between Alpine and Lakeside, June 17, 1906, *Brandegee* (UC); hill, between Julian and Cuyamaca, July 17, 1906, *Brandegee & Stockton* (UC); Laguna Mts., June 20, 1904, *Brandegee* (UC); near Valley Center, 360 m. alt., July 5, 1904, *Chandler 5440* (NY, UC); dry soil, foothills, La Jolla, June 6, 1914, *Clements & Clements 282* (F, G, NY, PA); Descanso, June 24, 1919, *Eastwood 9071* (CA); Cuyamaca, June 25, 1919, *Eastwood 9140* (CA); Flinn Springs, June 19, 1932, *Epling, Darsie, Knox & Robison* (CA, D, F, P, RM, UC, UCLA); Torrey Pines Park, June 25, 1935, *Epling & Robison* (UCLA); sandstone outcrops, near the Torrey Pines, just s. of Del Mar, 30 m. alt., Aug. 6, 1927, *Howell 2950* (CA); Palomar, May 17–June 1, 1901, *Jepson & Hall* (UC); Rincon Grade, May 29, 1926, *Jones* (P); e. of Julian, May 30, 1926, *Jones* (CA, D); Santa Ysabel, June 11, 1932, *Jones* (P, UC); Escondido, June, 1927, *Meyer 221* (UC); in clearing in chaparral, on dry slope, Alpine, June 27, 1923, *Munz & Harwood 7147* (P); about rocks, 2 mi. s. e. of Santa Ysabel, June 29, 1923, *Munz & Harwood 7312* (NY, P); rocky soil, along Cottonwood Creek, 1 mi. n. w. of Buckman Springs, June 23, 1938, *Ownbey & Ownbey 1657* (CA, D, F, G, Kew, M, NY, O, P, PA, RM, UC); dry, brushy hills, 2 mi. s. w. of Rainbow, June 25, 1938, *Ownbey & Ownbey 1665* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); Cuyamaca Mts., July 12, 1875, *Palmer 378* (F, G, NY, PA, UC); Rainbow P. O., Coast Range, June 17, 1897, *Parish 4458* (G, M, NY); Moreno Grade, June 29, 1897, *Reed* (P); high hill, La Jolla, June 17, 1895, *Snyder* (F); edge of woods, Pine Hills, 1260 m. alt., June 25, 1920, *Spencer 1601, 1601A* (G, P); chaparral, 6 mi. w. of Henshaw Dam, Palomar Mts., June 14, 1928, *Wiggins 3113* (D, UC, UCLA); ¼ mi. n. of Old Spanish Lighthouse, Point Loma, 60 m. alt., May 26, 1931, *Wolf 2070* (D); ½ mi. above Cottonwood Creek, on the Potrero Grade, 360 m. alt., May 27, 1931, *Wolf 2137* (D, UC).

LOWER CALIFORNIA. Ensenada, June 4, 1893, *Brandegee* (UC).

44a. Calochortus Weedii var. **vestus** Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 133. 1901.

Calochortus Weedii var. *purpurascens* Watson in Proc. Am. Acad. **14**: 265. 1879, as to specimen from Santa Barbara.

Petals triangular-obovate, truncate, purplish, with a conspicuous, reddish brown fringe, densely bearded on the inner face with yellow or reddish brown hairs; anthers lanceolate, apiculate; otherwise quite similar to the species.

The original publication of *C. Weedii* var. *purpurascens* included two elements. The collection from Santa Barbara, which is mentioned first, is probably that of Torrey cited below, but since the description is entirely of the second element, the name cannot properly be applied to the present entity. This is a well-marked variant between *C. Weedii* and *C. obispoensis,* much nearer, however, to the former than to the latter.

DISTRIBUTION. California: on dry hillsides, Santa Lucia Mountains, Monterey County, and near Santa Barbara, Santa Barbara County.

CALIFORNIA. MONTEREY CO.: Santa Lucia Mts., Aug., 1885, ex herb. *Brandegee* (G). SANTA BARBARA CO.: Santa Barbara, Aug., 1902, *Elmer 3740* (D, M, P); near Santa Barbara, Aug., 1909, *Goodwin* (G); dry hillside, Franklin Canyon Trail, beyond Carpenteria, July 24, 1923, *Grant 1699* (G, P); 2 mi. w. of La Cumbre Peak, July, 1939, *James* (O); without exact locality, *Torrey 519* (G, M, NY).

44b. Calochortus Weedii var. **peninsularis** Ownbey, n. var.[44]

Petals pale yellow, not fringed, sparingly bearded below the middle; otherwise similar to the species.

This variety appears to be quite constant, and is probably more frequent than the two known collections would indicate.

DISTRIBUTION. Mexico: mountains of northern Lower California.

LOWER CALIFORNIA. Brushy, northwest slope, hills n. e. of Valle Redondo, May 30, 1932, *Fosberg 8387* (D, P); granitic soil on foothills of Sierra San Pedro Martin, in the vicinity of Rancho San Jose, 25 mi. e. of San Telmo, 780 m. alt., March 1, 1931, *Meling 10* (D, NY, P, US TYPE).

44c. Calochortus Weedii var. **intermedius** Ownbey, n. var.[45]

Dried petals lilac to purple, conspicuously fringed at the apex and bearded on the inner face with long, yellow hairs; otherwise as in the species.

Although clearly intermediate between *C. Plummerae* and

[44] **Calochortus Weedii** var. **peninsularis** var. nov., petalis pallide aureis non fimbriatis infra medium parce barbatis; aliter similis speciei.

[45] **Calochortus Weedii** var. **intermedius** var. nov., petalis siccatis lilaceis vel purpureis apice insigniter fimbriatis, facie interiore pilis longis flavis barbatis; aliter similis speciei.

C. Weedii, this variety does not seem to be of simple hybrid origin. In the first place, neither of the above species appears to occur in the immediate vicinity, and, in the second, it shows little tendency to segregate either yellow flowers or unfringed petals. The type collection is marked "variable," but the variation shown is hardly greater than that found in either *C. Plummerae* or *C. Weedii.*

DISTRIBUTION. California: hills and canyons, Orange County.

CALIFORNIA. ORANGE CO.: Trabuco Canyon, June, 1901, *Abrams 1802* (D, M, NY); hills back of Laguna Beach, June 29, 1938, *Copeland* (O); sandy soil on sandstone outcrop, hills on north side of Santa Ana Canyon, 240 m. alt., June 22, 1927, *Howell 2572* (CA TYPE, NY); dry, rocky slope, Claymine Canyon, Santa Ana Mts., 300 m. alt., July 3, 1927, *Howell 2636* (CA).

45. Calochortus obispoensis Lemmon in Bot. Gaz. **11**: 180. 1886.

Calochortus Weedii var. *obispoensis* Purdy in Proc. Calif. Acad. Ser. III. Bot. **2**: 133. 1901.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, erect, branched, not bulbiferous; basal leaf broad and long, usually withering before anthesis; cauline leaves linear, attenuate, becoming involute, reduced upward; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers small, erect, opening flat, with the sepals reflexed, petals orange, tipped with purplish brown; sepals greatly exceeding the petals, narrowly lanceolate, attenuate, glabrous; petals oblong, obtuse, fimbriate at the apex, conspicuously bearded with long, slender hairs; gland circular, slightly depressed, surrounded with a dense ring of slender, hair-like processes which are united at the base into a more or less continuous membrane; anthers oblong, obtuse or acute, about half as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear, acute, 3-angled, erect; seeds flattened, with minutely reticulate coats.

Its greatly reduced, profusely bearded petals give *Calochortus obispoensis* a curious appearance quite unlike that of any other species of the genus. It is closely allied to *C. Weedii,* but this affinity is evident only after close examination.

DISTRIBUTION. California: dry hills and canyons, San Luis Obispo to Arroyo Grande, San Luis Obispo County.

CALIFORNIA. SAN LUIS OBISPO CO.: hills n. e. of San Luis Obispo, May 7, 1936, *Eastwood & Howell 2246* (CA); Serrano Canyon, June 14, 1938, *Eastwood & Howell 5942* (CA); dry, gravelly hillside, in chaparral, between San Luis Obispo and Pismo, 270 m. alt., June 3, 1928, *Hitchcock 5* (P); Steele's Ranch, 1885, *Lemmon* (UC); San Luis Obispo, June, 1886, *Lemmon* (G); Arroyo Grande, 1895, *Lowe* (UC); dry, rocky, clay soil, Reservoir Canyon, about 3 mi. n. e. of San Luis Obispo, July 4, 1938, *Ownbey & Ownbey 1692* (CA, Clokey, D, F, G, Kew, M, NY, O, P, PA, RM, UC, UCLA, UM, UO, US, WS); San Luis Obispo, 1915, *Reed* (G); Reservoir Canyon, June, 1930, *Rountree* (P); Reservoir Canyon, near San Luis Obispo, June 20, 1930, *Sinsheimer* (CA, F, G, M, P); Polytechnic Canyon, San Luis Obispo, May 28, 1934, *Sinsheimer* (NY); Santa Lucia Mts., June 8, 1882, *Summers 842* (UC); San Luis Obispo, 1886, *Summers* (G); Tunnel, San Luis Obispo, June 24, 1906, *Unangst* (UC).

Subsection 10. GHIESBREGHTIANI.[46]

Stems slender, simple or branched, flexuous, rarely bulbiferous in the axils of the upper leaves; flowers small, broadly campanulate, erect; petals obovate, cuneate, bearded near the base; glands present or absent; fruits linear, 3-angled, erect.

This subsection may be recognized by its small, erect flowers and inconspicuously bearded petals. Three of its four species, *C. venustulus, C. Hintoni* and *C. exilis,* are closely related; the fourth, *C. Ghiesbreghtii,* only remotely so. In the first three, the gland is obscure or lacking, while, in the last, there are glands on both petals and sepals. In this character and in the occasional presence of bulblets in the axils of the upper leaves, *C. Ghiesbreghtii* connects the subsection GHIESBREGHTIANI with the subsection BARBATI.

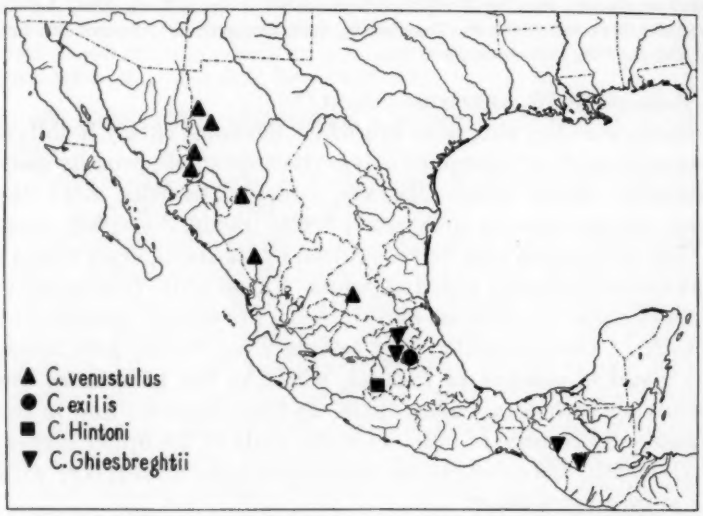
46. Calochortus venustulus Greene, Pittonia **1**: 158. Jan., 1888; *ibid.* 225.

Calochortus madrensis Watson in Proc. Am. Acad. **23**: 283. May, 1888.

Bulb ovoid, with fibrous-reticulate coats; stem slender, erect, flexuous, usually branched, not bulbiferous; basal leaf linear, acute to acuminate, about equalling the stem; cauline leaves

[46] GHIESBREGHTIANI subsect. nov., caulibus gracilibus simplicibus aut ramosis flexuosis raro in axillis foliorum superiorum bulbiferis; floribus parvis late campanulatis erectis; petalis obovatis cuneatis prope basem barbatis; glandulis aut praesentibus aut absentibus; capsulis linearibus triangulatis erectis.

linear, attenuate, reduced upward; inflorescences usually 2-flowered, the bracts similar to the uppermost leaf; flowers erect, broadly campanulate, clear yellow or with the sepals sometimes purplish; sepals equalling the petals, elliptic, acute or obtuse, glabrous except for a few short hairs near the base; petals obovate, cuneate, obtuse or acute, densely bearded near the base with short hairs; gland inconspicuous or absent; anthers linear-oblong, obtuse or acute, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a per-



Map 10. Distribution of the species of the subsection GHIESBREGHTIANI.

sistent, trifid stigma; fruit linear-oblong, acute, 3-angled, erect; seeds irregular, with minutely reticulate coats.

Calochortus venustulus is closely allied to only *C. exilis* and *C. Hintoni*. From *C. exilis*, it is distinguished by its larger size, yellow flowers, longer capsules and proportionately shorter and broader basal leaf; from *C. Hintoni*, by its flower color and distribution.

DISTRIBUTION. Mexico: in the Sierra Madre of Chihuahua and Durango; also apparently in San Luis Potosi.

CHIHUAHUA. On dry rock ridge, Sierra Charuco, Rio Fuerte, Sept. 13, 1935, *Gentry 1819* (F, G, M, UC, US); rock shale, on the cold shoulder of the peak of

Cascaron, Los Cascarones, Rio Mayo, Sept. 11, 1936, *Gentry 2670* (F, G, UC, US); Soldier Canyon, Sierra Madre, 1800 m. alt., Sept. 16, 1903, *Jones* (D, M, P, US); Culebra Mts., Aug. 18, 1936, *LeSueur 577* (F); near Colonia Garcia, Sierra Madre, Aug., 1899, *Nelson 6108* (G, NY, US); pine plains, base of the Sierra Madre, Sept. 20, 1887, *Pringle 1382* (F, G, NY, PA, UO, US), type collection of *C. madrensis* Watson; Sierra Madre, 2100–2850 m. alt., Sept. 29, 1888, *Pringle 1679* (NY, UC); near Colonia Garcia, Sierra Madre, 2400 m. alt., July 20, 1899, *Townsend & Barber 155* (F, G, M, NY, P, PA, RM, UC, US).

DURANGO. Sierra Madre, w. of Durango, 2430 m. alt., Sept., Oct., 1881, *Forrer* (F, G, NY, PA, UC, US), TYPE COLLECTION; Sierra Madre, 15 mi. n. of Guanacevi, 2250–2400 m. alt., Aug. 17, 1898, *Nelson 4761* (US).

SAN LUIS POTOSI. Minas de San Rafael, Nov., 1910, *Purpus 5061* (UC). This collection has smaller flowers and shorter fruits than any other examined, and may possibly represent an undescribed variety intermediate between *C. venustulus* and *C. exilis*.

47. Calochortus exilis Painter in Contrib. U. S. Nat. Herb. 13: 346. 1911.

Bulb ovoid, with fibrous-reticulate coats; stem very slender, erect, flexuous, often branched, not bulbiferous; basal leaf narrowly linear, attenuate, usually much longer than the stem; cauline leaf similar, but much shorter; inflorescences usually 2-flowered, the bracts linear-lanceolate, acute, unequal; flowers small, erect, broadly campanulate, white or yellowish, usually with the sepals purplish; sepals equalling the petals, oblong, acute or obtuse, glabrous except for a few short hairs near the base; petals obovate, cuneate, obtuse or acute, densely bearded near the base with short hairs; gland inconspicuous or absent; anthers oblong, short-apiculate, about equalling the basally dilated filaments in length; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit narrowly lanceolate, acute, 3-angled, erect; mature seeds unknown.

Calochortus exilis is the smallest species of the section CYCLOBOTHRA. It is closely allied to *C. venustulus*, but constantly differs in its more slender habit, proportionately longer and narrower basal leaf, smaller, paler flowers, and shorter, thicker capsules.

DISTRIBUTION. Mexico: in the mountains of Hidalgo.

HIDALGO. Cerro de los Navajos, Mineral del Monte, Nov., 1835, *Ehrenberg 501* (G); bare summits, Sierra de Pachuca, 3000 m. alt., Sept. 14, 1899, *Pringle 8247* (F, G, M, NY, P, PA, RM, UC, US TYPE); Sierra de Pachuca, 3000 m. alt., Aug. 28, 1906, *Pringle 13798* (G, US); Sierra de Pachuca, Sept. 24, 1906, *Rose & Rose 11492* (NY, US).

48. Calochortus Hintoni Bullock in herb., n. sp.[47]

Bulb ovoid; stem slender, erect, flexuous, branched, not bulbiferous; basal leaf linear, attenuate, about equalling the stem; cauline leaves linear, attenuate, reduced upward; inflorescence usually 2-flowered, the bracts similar to the uppermost leaf; flowers erect, broadly campanulate, apparently dark red, drying brown; sepals slightly shorter than the petals, elliptic-lanceolate, acute or obtuse, glabrous except for a few slender hairs near the base; petals obovate, cuneate, obtuse or acute, densely bearded near the base with slender hairs; gland inconspicuous or absent; anthers elliptic, obtuse or acute, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a trifid stigma; fruit and seeds unknown.

Calochortus Hintoni is closely allied to *C. venustulus* and *C. exilis*, but differs from both in flower-color and distribution. The flowers in the dried condition are a rich chocolate-brown.

DISTRIBUTION. Mexico: known only from the District of Temascaltepec, State of Mexico.

MEXICO. Oak woods, Cerro Muñeca, District of Temascaltepec, 2300 m. alt., Aug. 18, 1932, *Hinton 1383* (M), TYPE COLLECTION; oak woods, Limones, District of Temascaltepec, 910 m. alt., Sept. 12, 1933, *Hinton 4739* (M).

49. Calochortus Ghiesbreghtii Watson in Proc. Am. Acad. **14**: 268. 1879.

Calochortus Ghiesbreghtianus Watson in Jackson, Index Kewensis **1**: 390. 1893, in error.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, erect, flexuous, often branched, rarely bulbiferous in the axils of the upper leaves and bracts; basal leaf linear, attenuate, nearly as long as the stem; cauline leaves linear, attenuate, successively shorter upward; inflorescences usually 2-

[47] **Calochortus Hintoni** Bullock in herb., sp. nov., bulbo ovoideo; caule gracili erecto flexuoso ramoso non bulbifero; folio basali lineari attenuato cauli subaequilongo; foliis caulinis linearibus attenuatis, sursum ex ordine brevioribus; inflorescentia plerumque 2-flora, bracteis folio summo similibus; floribus erectis late campanulatis obscure rubris ut videtur, in siccis fuscantibus; sepalis petalis leviter brevioribus elliptico-lanceolatis acutis vel obtusis, glabris praeter paucos pilos graciles prope basem; petalis obovatis cuneatis obtusis vel acutis, prope basem pilis gracilibus dense barbatis; glandula inconspicua vel absente; antheris ellipticis obtusis vel acutis filamentis basilariter dilatatis brevioribus; ovario lineari non alato, stigmate trifido; capsula seminibusque ignotis.

flowered, the bracts similar to the upper leaves; flowers erect on often greatly elongate pedicels, broadly campanulate, purplish; sepals about as long as the petals, elliptic, acute or obtuse, with a circular, glandular spot near the base, which is bordered above with a horseshoe-shaped, deeply laciniate membrane; petals obovate, cuneate, acute or obtuse, sparsely to densely bearded about the gland with short hairs which are distally more or less thickened and glandular; gland not depressed, naked, bordered above with a membrane like that on the sepals; anthers linear-lanceolate, apiculate, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, 3-angled, erect; mature seeds unknown.

Calochortus Ghiesbreghtii is readily distinguished by its erect, purplish flowers, with glands on both petals and sepals.

DISTRIBUTION. Mountains of Hidalgo and Chiapas, Mexico, southward to Guatemala.

HIDALGO. Jacala, Aug. 14, 1937, *Edwards 812* (F); Jacala, 1500 m. alt., Aug. 14, 1937, *Fisher* (M); Jacala, Nov. 17, 1937, *Kenoyer 462* (F); Ixmiquilpan, Aug., 1905, *Purpus* (UC).

CHIAPAS. Without exact locality, *Ghiesbreght 104* (G); on rocks, Aug., Sept., 1864–1870, *Ghiesbreght 661* (F, G TYPE, M); near San Cristobal, 2100–2640 m. alt., Sept. 18, 1895, *Nelson 3158* (G, US).

GUATEMALA. On lightly wooded calcareous mountains, Trinidad, Department of Huehuetenango, Aug. 13, 1896, *Seler & Seler 3200* (G).

Subsection 11. BARBATI.[48]

Stems erect, flexuous, usually branched, often bulbiferous in the axils of the upper leaves; flowers small, broadly campanulate, nodding; petals obovate to spatulate, conspicuously bearded; glands usually present; fruits linear or lanceolate, 3-angled, erect.

The BARBATI are characterized by their nodding flowers and conspicuously bearded petals. The four species here recognized are very distinct, and probably not closely related.

50. Calochortus barbatus (HBK.) Painter in Contrib. U. S. Nat. Herb. **13**: 348. 1911.

[48] BARBATI subsect. nov., caulibus erectis flexuosis plerumque ramosis, saepe in axillis foliorum superiorum bulbiferis; floribus parvis late campanulatis cernuis; petalis obovatis vel spathulatis insigniter barbatis; glandulis plerumque praesentibus; capsulis linearibus aut lanceolatis triangulatis erectis.

Fritillaria barbata Humboldt, Bonpland & Kunth, Nov. Gen. & Sp. Pl. **1**: 288. 1816; **7**: *t. 677*. 1825.

Cyclobothra barbata [D. Don in] Sweet, Brit. Fl. Gard. **3**: *t. 273*. 1828.

Calochortus flavus Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 134. 1829; Schultes & Schultes, Syst. Veg. **7**: 1535. 1830.

Cyclobothra flava Lindley in Bot. Reg. **20**: under *t. 1662*. 1834.

Calochortus pallidus Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 129. 1829; Schultes & Schultes, Syst. Veg. **7**: 1533. 1830.

Cyclobothra pallida Lindley in Bot. Reg. **20**: under *t. 1662*. 1834.

Cyclobothra lutea Lindley in Bot. Reg. **20**: *t. 1663*. 1834.

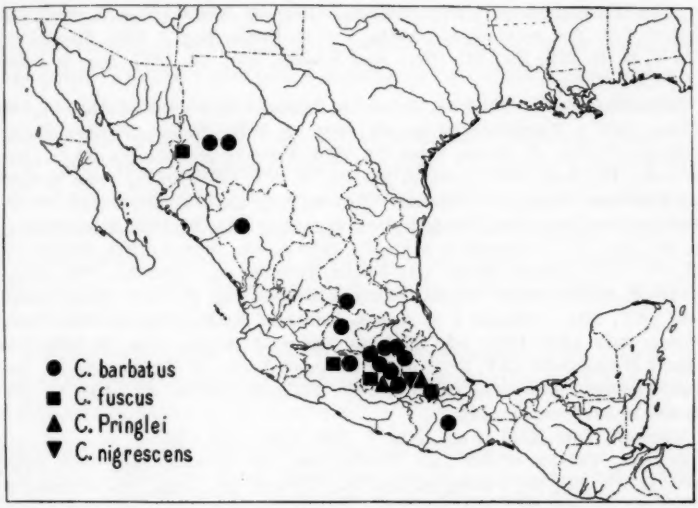
Cyclobothra propinqua Schauer apud Nees & Schauer in Linnaea **19**: 701. 1847.

Calochortus barbatus subsp. *chihuahuanus* Painter in Contrib. U. S. Nat. Herb. **13**: 349. 1911.

Calochortus barbatus var. *chihuahuanus* Macbride in Contrib. Gray Herb. N.S. No. 59, p. 28. 1919.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, erect, flexuous, usually branched, rarely bulbiferous in the axils of the upper leaves and bracts; basal leaf broadly linear, attenuate, shorter than the stem; cauline leaves successively shorter upward, linear to linear-lanceolate, attenuate; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, yellow or with the petals sometimes and the sepals often purplish; sepals shorter than the petals, lanceolate, acute or obtuse, sparsely bearded within, often with a gland like those on the petals; petals obovate, cuneate, obtuse to acuminate, fringed laterally and densely bearded on the inner face to below the gland with slender hairs; gland sometimes depressed, more or less circular to indefinite in outline, naked; anthers oblong, short-apiculate, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute, 3-angled, erect; seeds irregular, with minutely roughened coats.

Calochortus barbatus is a widespread and variable species. The variety *chihuahuanus* differs only in its purplish petals, and this character does not hold throughout the type collection. The species, as a whole, is easily recognized by its broad, densely bearded petals, linear fruits and yellow flowers. Its closest ally is *C. fuscus*.



Map 11. Distribution of the species of the subsection BARBATI.

DISTRIBUTION. Throughout the plateau region of Mexico, from Chihuahua to Oaxaca.

CHIHUAHUA. Majalca, Aug. 18–20, 1935, *LeSueur 94* (F); Santa Eulalia Mts., Sept. 1885, *Pringle 328* (F, G, NY, PA, US, type of *C. barbatus* ssp. *chihuahuanus* Painter); mesas near Cusihuiriachic, Aug. 29, 1887, *Pringle 1580* (M, UC); Santa Eulalia Hills, Sept. 1, 1885, *Wilkinson* (US).

DURANGO. Papasquiaro, Aug. 7, 1898, *Nelson 4667* (G, US); Santiago Papasquiaro, Aug., 1896, *Palmer 415* (F, G, M, NY, UC, US).

SAN LUIS POTOSI. Region of San Luis Potosi, 1800–2400 m. alt., 1878, *Parry & Palmer 891* (G, M, PA, US); San Luis Potosi, 1879, *Schaffner 229* (F, NY, US); San Miguelito Mts., 1876, *Schaffner 542* (G, PA).

GUANAJUATO. Mountains, Guanajuato, Sept., 1903, *Dugès 3* (G).

MICHOACÁN. Punguato, vicinity of Morelia, 2100 m. alt., July 16, 1909, *Arsène 3039* (CA, F, G, M, NY, US); same locality, 1950–2000 m. alt., Aug. 18, 1910, *Arsène 5267* (CA, F, G, M, NY, UC, US); n. of Loma del Zapote, vicinity of Morelia, 1950 m. alt., Aug. 4, 1910, *Arsène 6606* (US); Cerro San Miguel, vicinity

of Morelia, 2100 m. alt., Sept. 15, 1910, *Arsène 6909* (US); Punguato, Morelia, Aug. 8, 1911, *Arsène* (CA, F).

HIDALGO. El Chico, July, 1927, *Lyonnet 184* (US); mountains, El Chico, near Pachuca, Sept., 1906, *Purpus 1703* (F, G, M, NY, P, UC, US); between Pachuca and Real del Monte, Aug. 31, 1903, *Rose & Painter 6702* (G, NY, US); near El Salto, Sept. 16, 1903, *Rose & Painter 7084* (US); Sierra de Pachuca, July 20, 24, 1905, *Rose, Painter & Rose 8774* (US); between Somoriel and Las Lajas, Aug. 5, 1905, *Rose, Painter & Rose 9237* (NY, US).

MEXICO. Along Mexico City-Toluca Road, Valley of Mexico, 2400 m. alt., Sept. 9, 1935, *MacDaniels 490* (F); Pedregal, Valley of Mexico, Sept. 1, 1936, *MacDaniels 749* (F); meadows and banks, Flor de Maria, Aug. 1, 1890, *Pringle 3185* (D, F, G, M, NY, PA, UC, US); near Salazar, Sept. 14, 1903, *Rose & Painter 7048* (NY, US).

FEDERAL DISTRICT. Mixcoac, Lomas de Cacapula, 2300 m. alt., Aug. 11, 1913, *Arsène* (US); Tlalpam, 2250 m. alt., Aug. 3, 1924, *Fisher* (F, M); Tlalpam Pedregal, Valley of Mexico, Aug. 20, 1896, *Harshberger 161* (G, PA); Lomas de Santa Fe, Sept., 1927, *Lyonnet 185* (G, M, NY, US); among rocks in rather dry situations, Pyramid of Cuicuilco, Tlalpam, Aug. 15, 1935, *MacDaniels 36* (F); earth pockets, lava flow, Pedregal near San Angel, Aug. 16, 1929, *Mexia 2729* (F, M, NY, PA, UC); hills above Santa Fe, 2550 m. alt., Sept. 4, 1901, *Pringle 9302* (G, NY, US); grassy slopes, near Eslaba, 2400 m. alt., Sept. 18, 1903, *Pringle 11714* (F, G, US); near Tlalpam, Valley of Mexico, Aug. 20, 1903, *Rose & Painter 6457* (NY, US); Pedregal e. of Ajusco, Valley of Mexico, Sept. 8, 1903, *Rose & Painter 6842* (NY, US); near Tlalpam, Valley of Mexico, Aug. 14, 1905, *Rose, Painter & Rose 9440* (NY, US); near San Angel, Valley of Mexico, Aug. 15, 1905, *Rose, Painter & Rose 9485* (G, NY, US); Tlalpam, 2280 m. alt., Aug. 22, 1930, *Russell & Souviron 33* (US).

MORELOS. Toro, 2940 m. alt., Aug. 5, 1924, *Fisher 169* (US).

PUEBLA. Vicinity of San Luis Tultitlanapa, near Oaxaca, July, 1908, *Purpus 3466* (G, NY, UC, US); Cerro del Oro, 2400–2700 m. alt., Aug., 1909, *Purpus 3941* (UC).

OAXACA. Cerro de San Felipe, 2250 m. alt., Sept. 23, 1895, *Conzatti 703* (G); Cerro San Felipe, Distrito del Centro, 2000 m. alt., Sept. 20, 1908, *Conzatti 2250* (F); Valley of Oaxaca, 1650–2150 m. alt., Sept. 20, 1894, *Nelson 1428* (G, US); Sierra de San Felipe, 2100–2400 m. alt., Oct. 2, 1894, *Smith 745* (M, NY, US); La Carbonera, 2100 m. alt., Sept. 20, 1895, *Smith 791* (G).

STATE NOT DETERMINED. "Mexico," *Aschenborn 374*, photograph of specimen at Berlin (M), type collection of *Cyclobothra propinqua* Schauer; "in Mexico," *De Karwinski*, photograph of specimen at Munich (M), type of *Calochortus pallidus* Schultes f.

51. Calochortus fuscus Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 131. 1829; Schultes & Schultes, Syst. Veg. **7**: 1534. 1830.

Cyclobothra fusca Lindley in Bot. Reg. **20**: under *t. 1662*. 1834.

Calochortus spatulatus Watson in Proc. Am. Acad. **14**: 267. 1879.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, erect, branched, bulbiferous in the axils of the upper leaves and bracts; basal leaf linear, attenuate, not exceeding the stem; cauline leaves successively shorter upward, the lower ones linear, the upper ones linear-lanceolate, amplexicaul; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, brownish or purplish; sepals shorter than the petals, obtuse or acute, with a median, oblong, glandular spot which is bordered above with a horseshoe-shaped, deeply laciniate membrane; petals narrowly elliptic to oblanceolate-spatulate, acute or obtuse, ciliate distally and sparsely bearded above the gland with slender, crisped hairs; gland not depressed, oblong, naked, bordered above with a membrane like that on the sepals; anthers linear-oblong, apiculate, less than half as long as the slender, basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute at both ends, erect; mature seeds unknown.

Calochortus fuscus is related to *C. barbatus,* from which it differs in its narrower perianth segments, less densely bearded petals and the color of the flowers.

DISTRIBUTION. Mexico: mountains, Chihuahua to Oaxaca.

CHIHUAHUA. Tilted oak glens, Guasaremos, Rio Mayo, Aug. 15, 1936, *Gentry 2385* (F, G); pine-oak country, Sierra Canelo, Rio Mayo, Aug. 30, 1936, *Gentry 2532* (UC, US).

MICHOACÁN. Cerro Azul, vicinity of Morelia, 2200 m. alt., 1910, *Arsène 6753* (US).

MEXICO. "In Mexico ad Arismendi, September 1827," *De Karwinski,* photograph of the TYPE in the herbarium at Munich (M); Temascaltepec, District of Temascaltepec, 1750 m. alt., Aug. 30, 1932, *Hinton 1441* (US); same locality, Sept. 1, 1932, *Hinton 1512* (F, M); Chorrera, District of Temascaltepec, 1230 m. alt., Sept. 24, 1932, *Hinton 1824* (M, NY); San Lucas, District of Temascaltepec, Sept. 14, 1933, *Hinton 4752* (M, US).

OAXACA. Without exact locality, 1842, *Ghiesbreght* (G, type of *C. spatulatus* Watson).

52. Calochortus Pringlei Robinson in Proc. Am. Acad. **36**: 472. 1901.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, erect, branched, bulbiferous in the axils of the upper leaves and bracts; basal leaf broadly linear, attenuate, not exceeding

the stem; cauline leaves successively shorter upward, linear to linear-lanceolate, attenuate; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers small, broadly campanulate, nodding, apparently dark reddish brown; sepals shorter than the petals, oblong, obtuse or acute, with a tuft of slender hairs in the middle, and a glandular depression below; petals obovate, cuneate, short-acuminate, more or less ciliate laterally and bearded above the gland with slender, crisped hairs; gland slightly depressed, rounded distally, but indefinite below, naked; anthers oblong, short-apiculate, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit elliptic-lanceolate, acute, 3-angled, erect; seeds irregular, with minutely roughened coats.

Calochortus Pringlei is allied to *C. barbatus,* but is readily distinguished by the color of its flowers and its much thicker, shorter capsules.

DISTRIBUTION. Mexico: mountains of Morelos and Puebla.

MORELOS. Thin soil of the top of the knobs of the Sierra de Tepoxtlan, 2250 m. alt., Sept. 12, 1900, *Pringle 8435* (F, G TYPE, M, NY, P, PA, RM, UC, US).

PUEBLA. Los Tepates, 2100–2400 m. alt., Aug., 1909, *Purpus 3930, in part* (G, M, NY, UC).

53. Calochortus nigrescens Ownbey, n. sp.[49]

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender, often very short, more or less flexuous, branched, not bulbiferous; basal leaf linear, attenuate, greatly exceeding the stem; lower cauline leaves linear, attenuate, upper ones successively shorter; inflorescences 1–2-flowered, the bracts similar to the

[49] **Calochortus nigrescens** sp. nov., bulbo ovoideo tunicis crassis fibroso-reticulatis; caule gracili saepe brevissimo subflexuoso ramoso non bulbifero; folio basali lineari attenuato caulem multo superante; foliis caulinis inferioribus linearibus attenuatis, superioribus ex ordine brevioribus; inflorescentiis 1–2-floris, bracteis foliis superioribus similibus; floribus campanulatis cernuis perobscure rubris ut videtur, in siccis paene nigrescentibus; sepalis petalis subaequilongis lanceolatis acutis infra medium fasciculo pilorum brevium; petalis oblanceolatis acuminatis pilis brevibus rectis dense barbatis non ciliatis; glandula circulari non depressa processis brevibus subclavatis circumdata; antheris oblongo-lanceolatis apiculatis filamentis basilariter dilatatis subduplo brevioribus; ovario lineari non alato, stigmate persistente trifido; capsula lineari-oblonga acuta triangulata erecta; seminibus maturis ignotis.

upper leaves; flowers campanulate, nodding, apparently very dark red, drying nearly black; sepals nearly equalling the petals, lanceolate, acute, with a tuft of short hairs below the middle; petals oblanceolate, acuminate, densely bearded with short, straight hairs, not ciliate; gland circular, not depressed, surrounded with short, subclavate processes; anthers oblong-lanceolate, apiculate, about half as long as the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute, 3-angled, erect; mature seeds unknown.

Calochortus nigrescens has no close allies. Its hairy petals and nearly black flowers distinguish it at once from any other known member of the section. The type collection is perhaps somewhat depauperate, and is badly mixed with *C. Pringlei*, but the two may be separated at a glance.

DISTRIBUTION. Mexico: known only from the type locality.

PUEBLA. Los Tepates, 2100–2400 m. alt., Aug., 1909, *Purpus 3930, in part* (F, G, NY, UC, US TYPE).

Subsection 12. PURPUREI.[50]

Stems erect, usually stout, leafy, often branched, usually bulbiferous in the axils of the upper leaves; flowers campanulate, nodding; petals glabrous or sparsely bearded on the inner face; glands naked, often absent; fruits linear, erect or nodding.

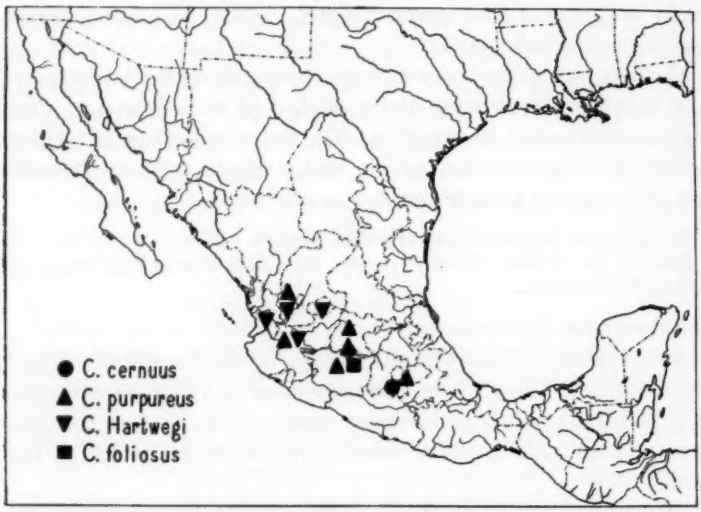
This subsection is distinguished by its leafy stems, nodding flowers, and sparsely bearded petals. Three of the species, *C. cernuus*, *C. purpureus* and *C. Hartwegi*, are closely allied, while the fourth, *C. foliosus*, is only remotely so. In superficial appearance, the species of the PURPUREI are strikingly similar to certain species of the genus *Fritillaria*.

54. Calochortus cernuus Painter in Contrib. U. S. Nat. Herb. 13: 347. 1911.

Bulb ovoid, with thick, fibrous-reticulate coats; stem slender,

[50] PURPUREI subsect. nov., caulibus erectis plerumque robustis foliatis saepe ramosis plerumque in axillis foliorum superiorum bulbiferis; floribus campanulatis cernuis; petalis glabris aut facie interiore parce barbatis; glandulis nudis saepe absentibus; capsulis linearibus erectis aut cernuis.

erect, usually branched, bulbiferous in the axils of the upper leaves and bracts; basal leaf linear, attenuate, equalling the stem in length; lower cauline leaves linear, the upper ones successively shorter and broader, lanceolate, attenuate, amplexicaul; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, purplish brown; sepals shorter than the petals, elliptic-lanceolate,



Map 12. Distribution of the species of the subsection PURPUREI.

acute, glabrous; petals narrowly elliptic, conspicuously ciliate above, invested with a few long hairs toward the tip; gland not depressed, blotch-like, naked; anthers oblong, short-apiculate, about half as long as the basally dilated filaments; ovary linear, not winged, tapering to a deeply trifid stigma; fruit and seeds unknown.

This species is very little known, and the two collections cited below are not absolutely identical. It is closely related to *C. purpureus,* differing only in the more slender stems, narrower leaves, smaller flowers, and more conspicuously fringed petals.

DISTRIBUTION. Mexico: known only from the State of Morelos.

MORELOS. El Parque, Aug. 31, 1910, *Orcutt 4088* (M, US); Sierra de Tepoxtlan, near Cuernavaca, 2250 m. alt., Sept. 12, 1900, *Pringle 9341* (G TYPE).

55. Calochortus purpureus (HBK.) Baker in Journ. Linn. Soc. Lond. Bot. **14**: 308. 1874.

Fritillaria purpurea Humboldt, Bonpland & Kunth, Nov. Gen. & Sp. Pl. **1**: 288. 1816.

Cyclobothra purpurea [D. Don in] Sweet, Brit. Fl. Gard. Ser. II. **1**: *t. 20.* 1829.

Calochortus Bonplandianus Schultes f. in Van Hall, Vrolik & Mulder, Bijdr. Nat. Wet. **4**: 128. 1829; Schultes & Schultes, Syst. Veg. **7**: 1532. 1830.

Cyclobothra grandiflora Martens & Galeotti in Bull. Acad. Brux. **9**[2]: 384. 1842.

Calochortus grandiflorus Painter in Contrib. U. S. Nat. Herb. **13**: 347. 1911, as to name-bringing synonym.

Bulb ovoid, with thick, fibrous-reticulate coats; stem stout, erect, leafy, often branched, bulbiferous in the axils of the upper leaves and bracts; basal leaf broadly linear, attenuate, about equalling the stem; lower cauline leaves linear, upper ones successively shorter, lanceolate, attenuate, amplexicaul; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, purplish brown; sepals shorter than the petals, oblong to lanceolate, acute or obtuse, glabrous, often with a glandular spot near the base; petals oblong to spatulate, acute or obtuse, more or less ciliate and usually sparsely bearded toward the tip; gland not depressed, more or less circular, naked, sometimes lacking; anthers oblong, short-apiculate, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, deeply trifid stigma; fruit linear-oblong, acute, 3-angled, erect; mature seeds unknown.

Calochortus purpureus varies greatly in the size and shape of the perianth segments and in the amount of pubescence and ciliation of the petals. It is closely related to *C. Hartwegi*, but may be distinguished by its smaller flowers, broader leaves and bulbiferous habit. It is not so easily distinguished from its other near ally, *C. cernuus*, but in general has broader

leaves, stouter stems, larger flowers, broader perianth segments, and less conspicuously ciliate petals.

DISTRIBUTION. Southern plateau region of Mexico, from Guanajuato and Jalisco to Oaxaca.

GUANAJUATO. Guanajuato, 1880, *Dugès* (G); Moroleón, 1895, *Dugès* (G).

JALISCO. Rio Blanco, Aug. 15, 1886, *Palmer 338* (G, M, NY, PA, US); slopes of canyons, near Guadalajara, Sept. 28, 1889, *Pringle 2329* (F, G, M, NY, PA, UC, US); bluffs of barranca, near Guadalajara, Sept. 10, 1890, *Pringle 3456* (F); road between Huejuquilla and Mesquitic, Aug. 25, 1897, *Rose 2589* (G, US); near Guadalajara, Sept. 28, 1903, *Rose & Painter 7381* (US).

MICHOACÁN. Punguato, vicinity of Morelia, 2100 m. alt., Aug. 9, 1909, *Arsène 2878* (CA, F, G, M, NY, US); Coronilla, vicinity of Morelia, Sept. 19, 1909, *Arsène* (US); Punguato, vicinity of Morelia, 1950 m. alt., Aug. 18, 1910, *Arsène* (G, M, US); same locality, 2000 m. alt., Aug. 25, 1910, *Arsène* (G, M, NY, US); La Huerta, vicinity of Morelia, 1950–2000 m. alt., Sept. 1, 1910, *Arsène 5581* (F, G, M, NY, UC, US); near Lake Patzcuaro, Aug., 1840, *Galeotti 5513* (Brussels, type of *Cyclobothra grandiflora* Mart. & Gal.; photograph, M).

MEXICO. Bluffs of barranca, below Ozumba, 2400 m. alt., Sept. 24, 1904, *Pringle 13223* (F, G, US); near Tlacotitlan, Aug. 28, 1903, *Rose & Painter 6621* (US).

MORELOS. In field, along the Mexico City-Cuernevaca Road, near Cuernevaca, 1650 m. alt., Aug. 28, 1935, *MacDaniels 285* (F).

OAXACA. Without exact locality, 1842, *Ghiesbreght* (G, US).

56. Calochortus Hartwegi Bentham, Pl. Hartw. p. 26. 1840.
Cyclobothra Hartwegi Kunth, Enum. Pl. **4**: 231. 1843.
Calochortus grandiflorus Painter in Contrib. U. S. Nat. Herb. **13**: 347. 1911, excl. syn.

Bulb ovoid, with thick, fibrous-reticulate coats; stem erect, sometimes branched, apparently not bulbiferous; basal leaf linear, elongate, about equalling the stem; cauline leaves linear to narrowly lanceolate, usually long-attenuate, amplexicaul, upper ones successively shorter and broader; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, purplish brown; sepals shorter than the petals, elliptic-oblong, obtuse or acute, glabrous or with a few hairs below the middle, usually with a glandular spot near the base; petals elliptic-oblong, acute or obtuse, ciliate, usually with a median, longitudinal line of short hairs; gland not depressed, more or less triangular, naked; anthers oblong, acute, about one-third as long as the basally dilated filaments; ovary linear, not winged, tapering to a deeply trifid stigma; fruit and seeds unknown.

Calochortus Hartwegi is closely allied to *C. purpureus,* and may represent only a well-marked variety of that widespread and variable species. It is distinguished by its usually larger flowers, narrower leaves and perianth segments, nearly naked petals, and apparent lack of bulblets in the axils of the upper leaves. These characters are none too convincing, and further collections may unite the two entities.

DISTRIBUTION. Mexico: in pastures, Aguascalientes, Nayarit and Jalisco.

AGUASCALIENTES. In mountain pasture, near Aguascalientes, *Hartweg 230* (G), TYPE COLLECTION.

NAYARIT. In pasture, Tecolote, Tepic, Oct. 3, 1923, *Collins & Kempton 48* (US).

JALISCO. Rio Blanco, Sept. 20, 1886, *Palmer 580* (G, NY, US); Sierra Madre, w. of Bolaños, Sept. 15–17, 1897, *Rose 2949* (US); vicinity of Rio Blanco, near Guadalajara, Sept. 30, 1903, *Rose & Painter 7445* (G, US).

57. Calochortus foliosus Ownbey, n. sp.[51]

Bulb unknown; stem rather slender, erect, very leafy, branched, bulbiferous in the axils of the upper leaves and bracts; cauline leaves linear-lanceolate, long-attenuate, the lower ones exceeding the stem, the upper ones successively shorter and amplexicaul; inflorescences usually 2-flowered, the bracts similar to the upper leaves; flowers campanulate, nodding, apparently bluish; sepals shorter than the petals, lanceolate, acute, glabrous; petals narrowly elliptic-oblanceolate, obtuse, sparsely bearded; gland not depressed, more or less circular, naked; anthers oblong, short-apiculate, shorter than the basally dilated filaments; ovary linear, not winged, tapering to a persistent, trifid stigma; fruit linear-oblong, acute at both ends, nodding; mature seeds unknown.

Calochortus foliosus is one of the most unusual species of the genus. Although it is related to *C. purpureus,* its nodding

[51] **Calochortus foliosus** sp. nov., bulbo ignoto; caule subgracili erecto foliatissimo ramoso bulbifero in axillis foliorum superiorum et bractearum; foliis caulinis lineari-lanceolatis longe-attenuatis, inferioribus caulem superantibus, superioribus ex ordine brevioribus amplexicaulibus; inflorescentiis plerumque 2-floris, bracteis foliis superioribus similibus; floribus campanulatis cernuis subcaeruleis ut videtur; sepalis petalis brevioribus lanceolatis acutis glabris; petalis anguste elliptico-oblanceolatis obtusis parce barbatis; glandula non depressa plus minusve circulari nuda; antheris oblongis brevi-apiculatis filamentis basilariter dilatatis brevioribus; ovario lineari non alato, stigmate persistente trifido; capsula linearioblonga utroque extremo acuta cernua; seminibus maturis ignotis.

capsules distinguish it from that and all other species of the section CYCLOBOTHRA, and its very leafy stems are not found in any other known species of *Calochortus*.

DISTRIBUTION. Mexico: known only from the type locality.

MICHOACÁN. Campanario, vicinity of Morelia, 2200 m. alt., Sept. 14, 1911, *Arsène 5687* (G, M, US TYPE).

EXCLUDED NAMES

Calochortus Barnardi Douglas in Steudel, Nomencl. Bot. ed. 2, 1: 260. 1840, nomen subnudum.

Calochortus Holtzei F. Mueller in Durand & Jackson, Index Kewensis, Suppl. I. p. 74. 1906 = **Calochilus Holtzei** F. Mueller.

Calochortus medius S. Wats. ex Hort. in Notizblatt Bot. Gart. Mus. Berlin 2: 318. 1899, nomen subnudum.

Calochortus pusillus Douglas in Steudel, Nomencl. Bot. ed. 2, 1: 260. 1840, nomen subnudum.

Calochortus vestitus Bentham in Steudel, Nomencl. Bot. ed. 2, 1: 260. 1840, nomen subnudum.

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The collector's numbers are indicated in *italics*, unnumbered collections by a dash. The numbers in parentheses are those of the species, varieties and hybrids, in this treatment.

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Bashor, Clara. — (8).

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Belshaw, C. M. *2039* (5).

Benke, H. C. *4195* (42).

Benner, Walter M. *5036* (42).

Bennitt, Dorman. *118* (35a).

Benson, Gilbert T. *19* (5).

Benson, Lyman. *3575, 3576* (1); *3591* (2); *2107* (6); *3255* (30); *2233* (34); *3491* (39).

Benson, S. B. *31* (23).

Bentley, Georgia. — (4); — (5); — (32).

Berry, Ada. — (43).

Berry, S. S. — (27).

Bethel, Ellsworth. — (5); — (6); — (7a); — (14); — (30).

Bidwell, Mrs. — (6).

Bingham, Mrs. — (22).

Bioletti, F. T. — (2); — (11); — (12); — (13).

Bioletti, T. T. — (32).

Birmingham, L. V., ex herb. — (30).

Bishop, F. M. — (35c).

Blair, Ray. — (8); — (17).

Blaisdell, F. E. — (2); — (5); — (32X).

Blankinship, J. W. — (4); — (6); *792* (8a); — (12); — (30).
Blankinship, J. W., ex herb. *61* (35).
Blasdale, W. C. — (2); — (29).
Bohinger, Ardis. *24* (10).
Bolander, H. N. *4530* (2); *3829, 6249* (4); *3933, 4712* (6); — (11); *4666, 4710* (12); *409* (32);
Bolander, H. N., & A. Kellogg. — (7).
Bonar, Lee. — (14).
Bowman, Agnes M. — (4); — (11); — (22); — (26); —, *127* (32).
Braem, Selma. — (23); *36* (35c); — (39).
Brandegee, Katharine. — (2); — (4); — (5); — (14); — (24); — (26); — (27); — (29); — (32); — (32X); — (38); — (39); — (44).
Brandegee, Katharine, & Mrs. S. F. Stockton. — (44).
Brandegee, T. S. — (2); — (15); —, *1107* (20); — (24); —, *3420* (26); — (27); — (33); — (34); — (36); — (38); — (40); — (42); — (44).
Brandegee, T. S., ex herb. — (7); — (14); — (22); — (26); — (34); — (35a); — (44a).
Brandt, R. P. — (3).
Branson, Ivan. — (30); — (32).
Brasher, W. — (6).
Braunton, Ernest. *268* (22); *6* (40); *131* (43).
Brewer, W. H. *592, 1157* (2); *1063, 1163* (3); *1035* (11); *656, 3960* (12); *507, 568* (26); *538, 1295* (29).
Bridges, Thomas. *284* (30).
Brodhead, Mrs. — (34).
Brown, A. L. D. *132* (16).
Brown, H. E. *190* (2); — (7a); *334* (14); *206* (32).
Bruce, Mrs. C. C. *2118, 2119* (2); *2116* (5); *2407* (6); —, *2405* (14); *2119* (32); — (34).
Brumback, Florence M., & Clara A. Davies. *22* (42).
Bryan, M. L. *53* (22).
Buffum, B. C. — (42).
Burnham, Stewart H. — (2); — (32).
Burns, Owen. *89* (10).
Burtness, A. C. — (10).
Burton, J. W. — (42).
Butler, B. T. *925, 926, 992, 3029* (10); *918, 919, 920, 921* (34); *5015* (35).
Butler, George D. *1260, 1508* (8b).
Buttle, Alvina F. — (26); — (38).

Camp, Miss. — (13).
Campbell, Ethel H. *1* (26).
Campbell, Marian L. — (12); — (33); — (36).
Canby, M. *239* (2); — (26).
Canby, William M. *325* (10); *327* (34); *326* (35).
Cannon, Evalina. — (11); — (14); — (32).
Carlson, John I. — (22).
Carlson, N. K. *298* (32).
Carruth, J. L. — (29).
Carruth, W. W. — (2); — (3); — (4); — (11); — (29); — (32).
Cassel, J. D. *158* (37).
Castetter, E. F. *2038* (35).
Chandler, Harley P. —, *376* (2); *7541* (4); *1049* (6); *1646* (8b); *482, 750* (11); *5111* (26); *7602* (32); — (36); *5440* (44).
Chesnut, V. K., & E. R. Drew. — (2); — (11).
Chittenden, Alice B. — (39).
Churchill, J. R. — (42).
Clark, Mrs. B. O. *213* (5).
Clark, Mrs. C. F. — (4).
Clark, June A. *75* (17); *68* (34).
Clarke, J. F. — (8).
Clausen, Jens. *815* (33).
Clayton, A. B. *83* (2).
Clemens, Mrs. Joseph. — (10); — (34).
Clemens, Mary Strong. — (14); — (33).
Clements, F. E., & E. S. Clements. *281* (26); *204, 347* (42); *282* (44).
Cletus, Bro. *245* (42).
Cleveland, D. — (38).
Climer, B. L. — (8).
Clokey, Ira W. *4882, 4883, 5168, 5169, 7841* (2); *7040, 7481, 7483* (23); *6539* (25); *6540* (26); *7043, 7047,*

7479, 7480, 7482 (35); *2763, 2864* (42).
Clokey, Ira W., & E. G. Anderson. *6544* (2); *6545* (22); *7139* (23); *6538* (25); *6543* (29); *6541, 6542* (39).
Clokey, Ira W., & C. B. Clokey. *7044, 7045, 7046* (35); *6993* (39).
Clokey, Ira W., C. B. Clokey & Bonnie C. Templeton. *4627* (26).
Clokey, Ira W., & Bonnie C. Templeton. *4426* (22); *4552* (40); *4579* (43).
Cloud, F. D. — (8).
Cobb, Benjamin. *76* (2); *134* (22).
Coghill, G. E. *78* (42a).
Coleman, G. A. — (32).
Collins, G. N., & J. H. Kempton. *197* (38); *48* (56).
Collom, Rose E. *74* (23); *157, 377* (39).
Condit, I. J. — (2); — (7a); — (11); — (14); — (25); — (26); — (29); — (36); — (40); — (43).
Condit & Edwards. — (40).
Congdon, J. W. — (2).
Congdon, J. W., ex herb. — (12); — (13).
Conger, Kate. — (5).
Constance, Lincoln. *173* (3); *769, 2138* (4); — (6); — (9); *333* (11); *2373* (13); *1951* (17); *2491* (26); *2227* (29); *L. F. Henderson 9962* (34).
Constance, Lincoln, & C. D. Jacobs. *1371, 1425* (17); *1316* (34).
Constance, Lincoln, & H. L. Mason. *2125* (1).
Constance, Lincoln, & J. L. Morrison. *2170* (2); *2172* (5); *2265* (26) *2266* (40).
Constance, Lincoln, Don Peters & Louis A. Dillon. *554* (8).
Constance, Lincoln, & Reed C. Rollins. *1919* (42).
Constance, Lincoln, R. C. Rollins & L. A. Dillon. *1602* (8).
Conzatti, C. *703, 2250* (50).
Coombs, Mrs. A. L. — (14).
Cooper, J. G. — (43).
Cooper, Mrs. R. D. — (34).
Cooper, W. S. *279* (42).
Copeland, E. B. *3023* (6); *353* (14); —, *3187* (32); *352* (33).
Copeland, H. F. —, *173* (2); —, *69, 1513* (14); — (32); — (44c).
Cottam, W. P. *4553* (35a).
Cottam, Stanton & Harrison. *3991, 4058* (23); *3992, 4150* (35).
Cotton, J. S. *393, in part* (16); *1266, 1313* (20); *393, in part, 462, 1339* (34).
Coues, Elliott, & Edward Palmer. *186* (39); — (41).
Coulter, John. *6* (33).
Coulter, John M. *1048* (17); *585* (35a).
Coville, Frederick V., & Elmer I. Applegate. *550* (9).
Coville, Frederick V., & Frederick Funston. *1447* (13); *978* (23); *1176, 1177* (29); — (36).
Cowen, J. H. — (42).
Cowgill, T. W. — (35a).
Cowles, Henry C. *222* (34).
Cowles, R. B. *1* (26).
Crambie, Mrs. J. E. — (32).
Crandall, C. S. *2474* (42).
Crawford, D. L. — (26); — (36).
Crawford & Hiatt. *586* (22).
Crow, E. — (40a).
Culbertson, J. D. *4219* (13); *4331* (36).
Cullen, J. J. — (34).
Cusick, William C. *3882* (6); *1894, 3238* (8); *2756* (15); — (17); *3433* (34); *2544* (35a).
Cutler, Hugh C. *1123* (23); *2344, 2431* (35); *2117* (35c); *1108* (41); *2467* (42).

Dale, Lois. — (6).
Daniels, Francis P. *53* (42).
Darlington, H. T. — (8).
Darsie, Marvin. — (35); — (35c); — (42).
Davidson, A. — (22); *2171* (25); *2672* (35a).
Davis, Hester R. — (6).
Davis, Horace. — (2).
Davis, N. J. *67* (30).

Davis, R. A. *53* (40a).
Davis, Ray J. *178-37, 700* (17); — (35).
Davy, Joseph Burtt. *5744½* (7a); *795* (11); *2608* (25); *1327* (32); *2480* (39).
Deane, George C. — (26).
Deasy, W. H. *6* (8).
DeGraw, Miss. — (1).
De Karwinski, D. — (50); — (51).
Demaree, Delzie. *9159* (32).
Derby, Mrs. Charles. — (13).
Detling, Le Roy. *2237* (35a); *2310* (42)
Dexter, H. R. — (22).
Douglas, David. — (2); — (3); — (12); — (17); — (26); — (29); — (32); — (34).
Drake & Dickson. — (6); — (34).
Draper, Charles H. — (42).
Drews, Robin. — (34).
Dudley, E. G. — (1).
Dudley, W. R. — (1); —, *4143* (2); — (4); — (5); — (6); — (7); — (12); —, *993, 1507, 1814* (13); — (14); — (26); —, *578, 1775, 4012, 4122* (29); — (30); —, *4024* (32); —, *830, 1455* (33); *327, 1940* (36); — (40).
Dudley, W. R., & F. H. Lamb. *4551, 4582, 4584* (29); *4603* (36); *4518* (39).
Dugès, Alfredo. *3* (50); — (55).
Duncan, W. B. *83* (1); *76* (29); — (30).
Dunkle, M. B. *426* (10); *1752, 1762* (22); *1922* (26).
Dunn, G. W. — (11); — (24).
Dunn, Nesta. — (2).
Durbrow, Pierson. — (36).

Eastwood, Alice. — (1); *93, 4338, 4975, 9137, 10558, 13582* (2); *4442, 11728* (3); —, *3286, 12746, 12789* (4); —, *10578, 11625, 14197* (5); —, *115, 3360, 12858, 15280* (6); *14456* (7); *11856* (7a); —, *12981* (11); *4186, 4632, 6879, 10336* (12); *1027* (13); *1109, 10791* (14); *955* (15); —, *19, 4956* (22); —, *6282, 8734, 16883, 17694, in part, 18463* (23); *488, 2933, 6945, 9182, 13811* (26); *595 in 1906, 753, 4445, 13905, 15144, 15169* (29); *595 in 1912, 795, 15187, in part* (30); *12664, 12664a, 15187, in part* (31); —, *308, 4385, 4629, 10546, 12624, 15173* (32); — (32X); *252, 321, 994, 14569, 14882* (33); *13320, 13413* (34a); —, *5129, 5347, 5654* (35); *5606* (35c); *9141* (38); *16882, 18041* (39); —, *394, 521* (40); *9002* (40a); *5791, 8416, 8837, 17087, 17304, 17549* (41); — (42); *58, 15408* (43); *9071, 9140* (44).
Eastwood, Alice, & John Thomas Howell. *5374* (1); *4336, 5946* (2); *4388* (4); *4345* (5); *1319, 1356, 1803, 4610A, 5698* (6); *4987* (7a); *4483, 4930, 5764* (12); *4526* (32); *1876* (32X); *556, 1212* (35); *2246, 5942* (45).
Eby, J. H. — (39); — (41).
Edwards. — (36).
Edwards, Harry. — (13).
Edwards, Helen M. — (6); — (30).
Edwards, Mary Taylor. *812* (49).
Edwards, O. T. *220* (20).
Eggleston, W. W. *7205* (14); *15281* (35); *19032* (42a).
Ehlers, Anna E. *882* (13); *828* (33).
Ehrenberg, C. *501* (47).
Eifrig, G. — (23).
Ellis, Charlotte C. *238* (42).
Ellison, Lincoln. — (2); — (10).
Elmer, A. D. E. *3222, 4846,* (2); *4631* (3); *62, 220* (8); *222* (16); *3962* (22); *3217* (26); *4164* (27); *3812, 4366, 4763* (29); *2037, 2971, 4353, 4600* (32); —, *393* (34); *3216, 3981* (36); *4175* (39); *3740* (44a).
Elmer, Alvina J. A. *44* (34).
Elrod, M. J. — (17); *18* (34).
Embree, F. W. *99* (14).
Engelmann, George. — (32); — (35); —(42).
English, Carl, Jr. — (9).
Epling, Carl. — (2); *5061* (6); — (8); — (8a); —, *5725 in 1929* (10);

— (16); — (22); — (26); *5725 in 1922* (34); — (35b); — (40).
Epling, Carl, & Harvey Anderson. — (22).
Epling, Carl, M. Darsie, C. Knox & Wm. Robison. *1078* (2); — (26); — (38); — (44).
Epling, Carl, & Nesta Dunn. — (36); — (39).
Epling, Carl, Nesta Dunn & Alice Goen. — (43).
Epling, Carl, & Lincoln Ellison. — (22).
Epling, Carl, & Joseph Ewan. — (26).
Epling, Carl, & J. M. Hauch [Houck]. *9199* (16).
Epling, Carl, & Wm. Robison. — (14); — (26); — (33); — (36); — (44).
Epling, Carl, & Wm. Stewart. — (26); — (39).
Epling, Carl, & Louis Wheeler. *1854* (40).
Epling, M. *8382* (2).
Essig, E. O. — (33).
Evans, Anna. *329* (8b).
Evans, Herbert McLean. — (29); — (33).
Evermann, Barton W. *628, 664* (17); — (22); — (29); — (42).
Ewan, Joseph. *3485* (22); *5514* (29); *5519* (40a).

Ferris, Roxana S. *6447, 6465* (4); *823, 7879, 7886* (29); *845, 6386* (32); *1427* (35a).
Ferris, Roxana S., & Rena Duthie. *744* (17); *6668* (34).
Ferris, Roxana S., & Laura Lorraine. *9344* (35).
Fiker, Charles B. *88* (20).
Fish, F. E. — (26).
Fisher, George L. — (49); —, *169* (50).
Fitch, Mrs. M. G. — (39).
Fleisher, Mary H. — (39).
Flett, J. B. *1124* (9); *1123* (15).
Flodman, J. H. *348* (42).
Fluto, J. Al. *884* (10).
Forrer, A. — (46).
Fosberg, F. R. *8167* (22); *8283* (26); *7986* (29); *8503* (36); *3502, 7935, 7936, 7937, 7938* (39); *8169* (40); *8387* (44b).
Foster, B. *15a* (34).
Fowler, J. — (34).
French, N. *370* (14).
Fritchey, J. Q. A. *39* (26).
Fuller, H. J. — (42).

Gaines, J. *72* (8).
Gale, Nettie P. —, *18, 43, 45, 84, 212, 215, 241* (6); *247* (12).
Galeotti, H. *5513* (55).
Gallegos, J. M. *925* (26).
Gander, Frank F. *2442* (36).
Gentry, Howard Scott. *1819, 2670* (46); *2385, 2532* (51).
Gessell, Vona. — (8).
Ghiesbreght, M. *104, 661* (49); — (51); — (55).
Gifford, A. D. *715* (39).
Gillespie, Doris Kildale. *9298* (5); *10586* (7a); *9266* (32).
Goddard, David R. *559* (41).
Goddard, P. E. *616, 627* (31).
Goldman, E. A. *1137* (38).
Goodding, Leslie N. —, *2215* (23); *96, 1056* (35); *405* (42).
Goodman, George J. *1868* (35).
Goodman, George J., & C. Leo Hitchcock. *1549, 1588, 1672* (35); *1723* (36); *1650* (41); *1355* (42).
Goodwin, M. B. — (44a).
Graff, A. T. — (4).
Graham, Edward H. *6361, 8166, 9000, 9029, 9076, 9139, 9158* (35); *3622* (39); *9832* (42).
Grant, Adele Lewis. *927* (11); *1687, in part* (26); *1007, in part* (29); *1007, in part* (32); *1142* (33); *1699* (44a).
Grant, George B. —, *2378* (22); —, *6647* (26); — (30); — (32); — (33); — (40); — (40a); *126* (43).
Grant, George B., & Walter Wheeler. *126a-1847* (22).
Gray, Asa. — (13); — (22).
Greata, L. A. *446* (26).

Green, E. A. — (5).
Greene, Edward Lee. — (12); *914* (18); *903* (21); — (25); *887* (28); *915* (34).
Greenman, Jesse More, & M. T. Greenman. *6044*, *6077* (42).
Griffiths, David, & J. S. Cotton. *415* (34).
Grinnell, F., Jr. — (12); — (36); — (43).
Grinnell, Joseph. — (2); *29* (36).
Grinnell, Joseph, & Hilda W. Grinnell. *1064a*, *1064b* (33); *1043a* (35a); *253* (36); *1047a* (39).
Gross, C. A. *13* (5); *223* (30).
Gunnison, F. W. — (29); — (32).
Gunnison's Expedition. — (42).

Hall, Elihu. *525* (6).
Hall, Harvey M. —, *1937*, *3213*, *10001*, *10151* (2); *10132* (3); *10923* (4); *9395* (7); *9558* (7a); — (11); *8878* (13); *8684* (14); *3137*, *3263* (22); *2014*, *9957* (26); *6265a*, *6265b*, *8988* (29); —, *9122* (30); *9058*, *9311* (33); —, *642*, *1212a*, *1452*, *2297*, *2475*, *6506*, *7655* (36); *962*, *2103*, *2285* (38); *6193*, *6314*, *6488* (39); *631*, *1417*, *1480*, *2015* (43); — (44).
Hall, Harvey M., & Ernest B. Babcock. *4033* (7a); *5641* (13); *4067*, *4321*, *4351* (14); *3307* (30); *4355* (33).
Hall, Harvey M., & H. D. Babcock. *5064* (29); *5426* (36).
Hall, Harvey M., & Harley P. Chandler. *177*, *4754* (13); *245* (29); *453* (33); *7187* (37).
Hammond, E. W. —, *389* (6); *390* (12).
Hanna, Leo A. *999* (35).
Hannibal, Edna. — (2).
Hanscom, Mrs. S. L. — (16).
Hansen, George. *46* (2); *47* (5); *1071* (7); *1126*, *1251* (29); *1250* (30); *589* (32); *1070*, *1252* (33).
Hanson, Herbert C. *A22A* (41); *C323* (42).
Harding, Thomas. *873* (10).
Harper, E. T., ex herb. — (42).
Harris, C. C., & S. K. Harris. *3330* (6).
Harrison, B. *5477* (23).
Harrison, G. J., & T. H. Kearney. *8612* (39).
Harshberger, J. W. *161* (50).
Hart, Cecil. *26* (26); *18* (29); *19* (36); *11* (39); — (40).
Harter, Mrs. H. C. — (1).
Hartweg, Theodor. *1984* (2); *1982*, *1987* (5); *1988* (7); *1986* (14); *230* (56).
Harwood, R. D. *4354* (36).
Hasse, H. E. *1047* (39).
Hastings, George T. — (22).
Hawkins, P. H. *937* (42).
Hawver, Elizabeth Parsons. — (4); — (9); — (32); — (33); — (35); — (42).
Hayden, F. V. — (17); — (35); — (42).
Haydon, Walton. *21*, *100* (6).
Hayward, Herman E. *711*, *798*, *1477*, *1515*, *1616*, *1622*, *2037*, *2113* (35); *2112*, *2341*, *2745* (42).
Head, Anna. — (4); — (33).
Hecht, Adolph. — (8a).
Heckner, J. H. — (6).
Hedges, Helen. — (2); — (5).
Heidenreich, V. *188* (9); *186* (15); *128* (20); *195* (34).
Heller, A. A. *6728*, *7395*, *8476*, *11375*, *14398* (2); *7364*, *13131* (4); *11295*, *13204* (5); —, *10116*, *10812*, *11946*, *13168*, *13630*, *14534* (6); *10812*, *14623* (7); —, *13386* (7a); *10143* (8); *6729* (12); *12066*, *12100* (14); *9385* (17); *8601* (29); *7845* (30); *13800* (31); —, *7387*, *8630*, *10760*, *11322* (32); *11424*, *13145* (32X); *7062*, *9755*, *11953* (33); *660* (34); — (35); *8328*, *9087*, *9753*, *10580* (35a); *8350* (37).
Heller, A. A., & H. E. Brown. *5484* (2); *5339* (4); *5263* (6); *5494* (32).
Heller, A. A., & E. Gertrude Heller. *3172* (8); —, *3397* (16).
Heller, A. A., & P. B. Kennedy. *8719* (33).

Henderson, Louis F. *15438* (4); —, *54, 983, 5784, 5988, 5989, 10134, 12263, 12458, 12679, 12784, 12786, 13578, 15432, 15445, 15455, 16170, 16294* (6); *2483* (8); *12881* (8b); —, *810, 932, 17581* (9); —, *1378, 5988, 12785, 16224* (12); —, *984* (15); *2484* (16); *4804, 5627, 5628* (17); *12809* (18); *2485* (20); —, *806, 5393, 8829, 12880* (34); *2727* (34a); —, *8827, 8828* (35a).
Henderson, Louis F., & J. R. Patterson. *14226* (9).
Hendrix, T. M. *212* (26).
Henshaw, H. W. — (26).
Herley, R. — (22).
Hermann, F. J. *4564* (35).
Herrin, Wm. F. — (7a).
Hiatt, Otis. — (26).
Hichborn, Deborah. — (2); — (6).
Hichborn, P. R. *275* (29); *260* (32).
Hilend, Martha. —, *15* (22); *319* (29); *78, 571* (36); —, *457* (39).
Hilend, Martha, & M. Canby Reis. — (2).
Hill, Grace A. — (8).
Hill, L. E. *10342* (43).
Hillman, F. H. — (35a).
Hinman, H. B. — (9).
Hinton, George B. *1383, 4739* (48); *1441, 1512, 1824, 4752* (51).
Hitchcock, C. Leo. — (2); *14* (3); *1900* (10); *2981* (23); — (26); — (29); *12345* (39); *5* (45).
Hitchcock, C. Leo, Roland V. Rethke & R. van Raadshooven. *3812* (17); *4493* (42).
Hoffmann, Ralph. — (2); — (22); — (32); *477* (35b); *273* (39).
Hollis, Mrs. C. W. — (14); — (33).
Hollis, M., & E. Hollis. *5724* (10).
Holman, R. M. — (1); — (6); — (30).
Hoover, R. F. *3471* (1); *3339* (3); *3186* (4); *3552* (26); *2453, 3414, 3488* (29); *2369, 2454, 3520* (30); *1179, 3491* (32); *3415* (40).
Hopping, Ralph. *107* (1); *40* (13).
Hormay, A. *H-132* (1); *H-155* (29).
Horner, Robert M. *B-485* (8); *463* (34).
Howden, W. R. *33* (33).
Howell, John Thomas. *5121* (1); *12989* (2); *1730, 6076* (4); *1909, 2310* (6); *6880* (8b); *7271* (9); *905, 11261* (11); *1757* (12); *27, 1238* (13); *13366* (14); *4773, 6186* (22); *4857, 6533* (26); *156, 413, 5055, 6471, 13814* (29); *130, 5161, 6675, 13863* (30); *8, 4258, 6496* (32); *91, 435, 1264, 1347, 12101, 14113* (33); *3900* (35b); *2733* (36); *2499* (39); *2770* (43) *2950, 6586* (44); *2572, 2636* (44c).
Howell, Joseph. — (6); — (12); — (19).
Howell, Joseph, & Thomas J. Howell. — (9).
Howell, Thomas J. —, *572* (6); *296* (8b); — (9); —, *295, 1396* (12); —, *560, 12577* (15); —, *294, 727, 1282* (19); — (34).
Hoyt, J. W. *42* (6).
Hoyt, Mrs. R. W. — (41).
Hughes, E. L. *64* (42).
Hughes, J. A. — (10).
Hull, W. R. *811* (8); — (34a).
Hunt, Clara. — (12).
Hunt, E. — (6).
Hunter, B. — (16).
Huntting, Mrs. H. H. — (16).

Illingsworth. *108* (40a).
Ingram, D. C. *1914* (9).
Irwin, Hardin. *64* (12).

Jackson, Belle Richardson. — (4).
Jaeger, Edmund C. — (35); — (38); — (39); — (41).
James, W. M. — (44a).
Jenkins & Street. *1953* (26).
Jenks, Gracia. — (26).
Jepson, Willis Linn. — (5); — (6); — (11); —, *6254* (12); —, *7656* (32).
Jepson, Willis Linn, & Harvey M. Hall. — (44).
Johnson, S. O. *147* (10).

Johnston, E. C. — (17).
Johnston, Ivan M. — (11); *1210* (22); — (25); *3777* (27); *1379, 1606* (36); —, *6487* (39); *2399* (42).
Jones, A. J. — (35).
Jones, E. — (6).
Jones, G. N. *981* (8); *5489* (10); *1891* (17).
Jones, Marcus E. — (2); — (4); — (5); — (6); — (9); —, *9213, 9214, 9215* (10); —, *3300* (14); —, *25180* (17); — (20); —, *3212, 26107* (22); —, *5029, 5187, 5249* (23); — (26); — (27); — (29); — (32); —, *2418* (33); —, *9216, 25182* (34); —, *1766, 5276, 5419, 5486, 5684, 5695, 25179, 26103* (35); —, *26104* (35a); — (36); — (37); — (38); — (39); — (40); —, *48, 25183, 25930* (41); —, *249* (42); — (43); — (44); — (46).
Jones, R. V. — (20).
Jones, Wyatt W. *50* (2); *47* (6); — (10); *46* (11); *119* (23); *344* (35).
Junkens, Anna. — (6).
Jussel, M. S. —, *191* (4); — (6); —, *93* (12); — (13); *270* (31); — (33).

Kammerer, Alfred L. *108* (34).
Kearney, T. H., & R. H. Peebles. *12182* (41).
Keck, David D. *1778* (2); *1019, 2330* (4); *412* (5); *1097* (12); *2815* (29); *173* (30); *2364* (31); *2280, 2416* (32); *1217* (33).
Keck, David D., & Palmer Stockwell. *3331* (1); *3228* (29); *3288* (39).
Keller, E. R. — (42).
Kelley, Junea. — (1); — (6).
Kelley, Mrs. S. Earle. — (5); — (11); — (14); — (33).
Kellogg, A. — (11); — (12); — (14).
Kellogg, A., & W. G. W. Harford. *991* (2); *990* (3); *1003, in part.* (11); *1003, in part* (12); *1001, 1002* (32).
Kelly, Isabel T. *8* (34).
Kelly, Marvin. *9* (34).
Kelsey, F. D. — (6); — (17).
Kemp, J. F. — (6).
Kendall, M. L. — (22).
Kennedy, P. B. *3002* (13); *3027* (33); *4095, 4580* (35); *13, 4471* (35a).
Kennedy, Wm. L. — (29); — (39).
Kenoyer, L. A. *462* (49).
Kienholz, Jesse. — (10).
Kienholz, R. — (9).
Kildale, Doris K. *2004, 4940* (4); *1851, 3248, 4596, 4604, 7451, 9934, 10563* (6); *5348* (7a); *3173* (30); *2033, in part* (31); *3174* (32); *2033, in part, 4981* (32X).
Kildale, Doris K., & J. W. Gillespie. *8279* (6).
Kildale, Doris K., & L. B. Kildale. *9599, 9636, 9686* (6); *9591* (12).
Kimball, J. P. — (35c).
Kimber, G. C., & Lucile Roush. — (32).
King, M. Alice. — (2); — (5); — (26); — (32); — (40).
King, Sid. *512* (17).
Kirtley, C. L. — (17).
Kirkwood, J. E. —, *1054* (8a); —, *1053* (10).
Knopf, Ezra C. *87, 107, 399, 417, 438, 439* (22); *213, 446* (26).
Knowlton, F. H. *81* (42).
Kramer, Joseph. *19* (10); *80* (35).
Krancer, A. H. — (14).
Kraus, F. G. — (4); — (32).
Kreager, Frank O. *391* (34).
Kunze, R. E. — (39).
Kusche, J. Aug. — (14).
Krukoff, B. A. — (10).

Lackey, Richard. *629* (35).
Lake, E. R., & W. R. Hull. *618* (16); — (34).
Lamb, F. H. — (32).
Large, Thomas. *46* (10).
Larson, Enid. — (13); — (33).
Lathrop, Laura M. — (13); — (26); — (29); — (33).
Lawrence, Wm. E. *1580* (6); *2929* (34).
Leach, Lilla. — (9); — (35a).
Leeds, B. F. — (2).
Leiberg, John B. *4018* (6); — (8); *1087, 1467* (8a); *4238* (8b); —,

1370 (10); *5066* (14); — (16); *2236* (35a).
Leithold, C. F. — (2).
Lemmon, J. G. — (2); —, *267* (14); — (29); — (38); *4175* (39); *1522, 4578* (40); — (45).
Lemmon, J. G., & Mrs. J. G. Lemmon. — (23); — (41).
Lemmon, Paul. — (10).
Le Sueur, Harde. *577* (46); *94* (50).
Lillard, J. B. — (13).
Little, E. E., & E. M. Stanton. *166* (35).
Lloyd, E. — (22).
Lloyd, Francis E. — (6); — (9).
Lobb, W. *257* (6); *242* (7); *243* (13).
Lockhart, Bruce. — (34).
Lodge, Elizabeth. *379* (12).
Lowe, Flora. — (45).
Luedinghaus, E. — (6).
Lyall, David. — (10); — (34).
Lyles, C. S. — (35a).
Lyon, W. S. — (22).
Lyonnet, E. *184, 185* (50).

McAllister, Mrs. D. B. — (6).
Macbride, J. Francis. *268, 1286* (34); *2752* (35); *2836* (42).
Macbride, J. Francis, & Edwin B. Payson. *2858, 2928, 3031* (17); *2845* (34); *2957, 3004* (35a); *762* (43).
McCracken, Isabel. — (23); — (39).
MacDaniels, L. H. *36, 490, 749* (50); *285* (55).
McDonald, Julia. — (1); — (30).
MacDougal, D. T. *151, 303, 584, 839* (10); *765* (34); *116* (35); *164* (41).
MacFadden, Fay A. *14163* (29).
McGregor, E. A. — (2); *50* (12); *6, 163* (13); *996* (26); *990* (38).
McIntosh, A. C. *307* (35); *464* (42).
MacKay, Ernest. *21* (34).
McKelvey, Mrs. Charles W. — (39); — (41).
McKelvey, Susan Delano. *2190* (23); *4646* (35); *4586, 4592, 4595, 4600* (35c); *2104, 2189, 2262* (39); *2107, 2150* (41).
McKenzie, Mrs. E. R. — (2).
Maclay, Anne. — (10).
McMurphy, Jas. *170* (6).
McMillen, F. — (6).
McNab, Anne. — (40).
Macoun, J. M. *70212* (20); —, *70200, 70211* (34).
Macoun, John. *13813, 25049* (10); — (34).
Maguire, Bassett, & H. L. Blood. *1310* (23).
Maguire, Bassett, Ruth Maguire & C. B. Maguire. *4753* (23); *15076* (32).
Maguire, Bassett, & J. D. Redd. *1705* (42).
Mann, Mrs. M. L. *1* (20).
Manning, Mrs. M. H. *8* (7a).
Manor, Harold V. — (3).
Marcelline, Sister M. *2146* (42).
Marsh, C. W. *9870* (42).
Marston, B. W. *161X, in part* (17).
Mason, H. L. —, 124 (2); — (11); — (29).
Mathias, Mildred E. *857* (2); *662* (41).
Matthews, W. — (34); *23* (35c).
Mayerhoff, Paul S. *112* (41).
Meany, E. S. — (6).
Mearns, Edgar A. *203, in part* (23); *3377* (38); *203, in part, 258* (39); —, *108* (41).
Mearns, Edgar A., & L. Schoenefeldt. *3471* (38).
Meehan, T. — (13).
Meiere, Mrs. Ernest. — (23); — (26).
Meling, Ada. *10* (44b).
Meredith, H. B. *4535* (35).
Merrill, E. D. — (14).
Merrill, E. D., & E. N. Wilcox. *789* (35).
Merrill, W. C. — (11); — (32).
Metcalfe, O. B. *55* (41); *494* (42).
Metz, Chas. W. *53* (2).
Mexia, Ynes. *2393* (4); — (17); *2389* (32); *2729* (50).
Meyer, C. V. *110* (26); *546* (36); *399* (38); *221* (44).
Meyer, Fred G. *251* (8); *1496* (9); *1500* (34).
Michener, C. A., & F. T. Bioletti. — (4); *2121* (11); — (31); — (32).

Miles, M. M. — (29); — (40).
Miller, C. E. — (2).
Miller, Mrs. C. E. — (22); — (32).
Mitchell, Mrs. H. M. — (5).
Moore, J. Percy. — (35).
Morrison, Mrs. J. H. — (2); — (5); — (6); — (14); — (32); — (32X).
Morrison, Miss. — (34).
Moxley, George L. *557* (1); *306* (22); *1114* (29); *1113* (40a).
Moyer, Lycurgus R. *523* (35).
Muenscher, Walter C. — (16).
Muir, John. *813* (13).
Mulford, A. Isabel. — (17); — (34); *119* (35).
Mulliken, Earle. *102* (2).
Munson, Beauford. *1021* (35).
Munz, Philip A. *8055* (2); *14450* (9); *2098, 10337* (22); *12595* (23); *8033, 8218, 8321, 9807* (26); *5740* (27); *6791, 6927, 6927a, 13224* (29); *7337, 8319* (30); *14856* (35b); *4651, 5749, 5856, 6073, 6109, 8380, 10469* (36); *5811, 5917, 8313, 8355, 9724, 10875* (38); *5744, 6818, 6933, 11913, 12441, 12518, 12542, 13671* (39); *6798* (40a); *2991* (42); *3274* (43); *7104* (44).
Munz, Philip A., & E. Crow. *11495, 11615* (22).
Munz, Philip A., & R. D. Harwood. *3977, 7233* (2); *3991* (22); *7314* (24); *3855, 7170* (26); *7147, 7312* (44).
Munz, Philip A., & Ivan M. Johnston. *5411* (26); *2919, 8636, 8651, 8776* (36); *5204* (39).
Munz, Philip A., Ivan M. Johnston & R. D. Harwood. *4259, 4275* (39).
Munz, Philip A., & David D. Keck. *4838* (23); *7094* (26); *7093* (36).
Munz, Philip A., Street & Williams. *2486, 2624* (22); *2625* (26).
Murdoch, John, Jr. *2560* (33); *4182* (42).

Nelson, Aven. *10374* (23); *7304, 9345, 9346* (35); *319, 1451, 7389, 7685* (42).
Nelson, Aven, & J. Francis Macbride. *1197* (17); *2149* (34); *1425, 1881* (35a).
Nelson, Aven, & Elias Nelson. *6814* (17).
Nelson, Aven, & Ruth Ashton Nelson. *527* (2); *557* (4); *1792, 1984, 2039* (23); *2168* (35c); *1468, 1503, 1701, 1850* (39); *876* (42).
Nelson, Elias. *4926* (35); *4500, 4897* (42).
Nelson, E. W. *4761, 6108* (46); *3158* (49); *1428, 4667* (50).
Nelson, J. C. —, *75, 578, 1158, 3595* (6).
Newell, Gwendolan. — (2); — (32).
Newhall, Mrs. C. S. — (1).
Nuttall, L. W. *6* (22); *216, 598* (26).
Nuttall, Thomas. — (17).

Orcutt, C. R. *532, 839* (24); — (38); *4088* (54).
Orr, Robert T. — (17).
Osterhout, George E. *1967, 4257, 5097, 7215* (35); *837, 838* (42).
Otis, I. C. *673* (20); *1945* (34).
Owens, C. E. — (6).
Owens, J. G. — (35c).
Ownbey, Gerald Bruce. *404* (35); *481* (42).
Ownbey, Marion. *788* (35); *217, 939, 1294* (42).
Ownbey, Marion, & Ruth Peck Ownbey. *1743* (7); *1724* (7a); *1748* (8b); *1797, 1799* (9); *1740, 1744* (14); *1800* (15); *1829, 1832, 1834, 1851, 1867* (17); *1770* (19); — (21); *1667* (22); *1664* (24); *1675* (25); *1660, 1685* (26); *1677* (27); *1686, 1689* (29); *1801, 1850* (34); *1670, 1690* (36); *1688* (39); *1666, 1681* (43); *1657, 1665* (44); *1692* (45).

Packard, Jacqueline. *273* (8); *459* (17); *247* (34).
Palmer, Edward. *376* (2); *527* (25); *452* (35); *526* (39); *378* (44); *415* (50); *338* (55); *580* (56).
Palmer, Ernest J. *37846* (34); *37032, 37322* (35).

Palmer, Ethel. — (23).
Parish, Samuel B. *4422*, *20038* (2); *11149*, *19296* (22); *1857* (25); *2075*, *11334* (26); *5000* (27); — (29); —, *3158*, *3159* (36); *2524* (38); *2467*, *2497*, *9296* (39); —, *11333* (43); *4458* (44).
Parish, Samuel B., & W. F. Parish. *357* (2); *586*, *1341* (25); *1342* (27).
Parish, W. F. *252* (41).
Park, Barry C. *57* (42).
Parker, Chas. S. *416* (8).
Parks, Harold E. — (11).
Parks, Harold E., & S. T. Parks. *605* (4); *0580* (32).
Parks, Harold E., & J. P. Tracy. *0790*, *11380* (6).
Parry, C. C. *260* (5); — (12); *265* (17); *254* (23); *255* (35).
Parry, C. C., & Edward Palmer. *891* (50).
Patterson, Miss, & Miss Wiltz. — (2); — (32).
Patterson, Francis D. — (5).
Patterson, Harry N. — (42).
Patterson, R. — (29); — (32).
Paulson, Myrtle. — (6).
Payson, Edwin Blake. *289*, *357* (23); *8* (35); *546* (42).
Payson, Edwin Blake, & George M. Armstrong. *3505*, *3506* (17); *3435* (35).
Payson, Edwin Blake, & Lois B. Payson. *1805* (8); *1850* (17); *2093*, *2521*, *2623*, *2736*, *4342* (35); *4085* (42).
Pearson, G. A. *347* (9).
Pearson, D., & E. Pearson. *52* (35).
Pease, Mrs. T. C. — (26).
Peck, Morton E. *1377*, *1378*, *3203*, *3204*, *9055*, *13719*, *14530a*, *14641a*, *14767*, *14996*, *17002* (6); *17625*, *18221* (8); *1379*, *9251*, *15019*, *18543*, *19273* (8b); *3200*, *3201*, *9807*, *13219*, *14641*, *16228*, *18780*, *18837* (9); *17200* (15); *3582*, *3583*, *3584*, *10325*, *17665*, *17711*, *17730*, *18219*, *176621* (17); *16381* (18); *1376*, *7848*, *8413* (19); *1373*, *1374*, *1375*, *3202*, *10106*, *16087*, *17656*, *18425*, *18632*, *18983* (34); *18963*, *18982* (35a).
Peebles, R. H. *8521*, (39); *6864*, *11323*, *11638* (41).
Peebles, R. H., & H. J. Fulton. *11414*, *11479* (39); *11436* (41).
Peebles, R. H., & G. J. Harrison. *3984* (39); *7073A* (41).
Peers, Susie. — (2).
Peirson, Frank W. *8876* (1); *6619* (4); *8093* (10); *10130* (14); *9942* (23); *4563* (27); *11588* (33); *2468* (40a).
Pendleton, R. L. *797* (2); *1480* (29); *915* (32).
Pendleton, R. L., & F. M. Reed. *1028*, *1073* (13); *1003*, *1250* (33).
Pennell, Francis W. *20646* (17); *21633* (35); *20614* (35a).
Pennell, Francis W., & R. L. Schaeffer, Jr. *23485* (17); *21748*, *21977a*, *22279*, *23079*, *23094* (35).
Peters, Don. *197* (9).
Phelps, Kate E. — (20).
Pickett, F. L. *1490* (8).
Pierce, W. M. — (22); — (27); — (29); — (36); — (40).
Piper, C. V. — (4); —, *5089* (6); *6398* (7a); — (8); *4104* (8a); —, *3777* (10); *6282* (12); —, *1680*, *in part* (16); —, *2460* (17); — (34); *1681* (34a); — (35a).
Plaskett, R. A. *139* (2); *148* (29).
Porter, Thomas C. — (35); — (42).
Pratt, Alice D. — (42).
Prescott, H. S. — (6); — (12).
Price, Gordon. — (8).
Price, John. — (30).
Price, W. W. — (7).
Pringle, C. G. *82* (14); — (39); — (41); *1382*, *1679* (46); *8247*, *13798* (47); *328*, *1580*, *3185*, *9302*, *11714* (50); *8435* (52); *9341* (54); *2329*, *3456*, *13223* (55).
Purdy, Carl. — (2); — (3); — (4); — (5); — (6); — (9); — (11); — (12); — (17); — (29); — (40).
Purer, Edith A. *6577*, *7269* (2); *6558* (22); *6523*, *6676*, *7267* (26).
Purpus, C. A. *871* (4); *879* (6); *1786* (13); *59* (35); *5013* (39); *8017*

(41); *60* (42); *5061* (46); — (49); *1703, 3466, 3941* (50); *3930, in part* (52); *3930, in part* (53).

Quibell, Chas. H. *1258* (1).
Quick, Clarence R. *1264, 1804* (13); *1278, 1828, 1858* (33).

Ramaley, Francis. *11300* (2); *11292* (5); *11290* (14); *11228* (32).
Ramaley, Francis, & W. W. Robbins. *3564* (42).
Rand, Mrs. W. W. *10* (32).
Randall, Alice D. —, *420, 444* (2); —, *155, 417* (12).
Randall, Josephine D. *219* (2); *225* (6); *221, 222* (32).
Randall, Merle. — (4).
Raphael, J. V. — (14).
Rattan, Volney. *13* (6); *60* (26); — (31).
Redfield, John H. — (42).
Reed, Eva M. — (42).
Reed, Kate. — (10).
Reed, Minnie. — (26); — (44).
Reed, Rhoda. — (45).
Reinhardt, George F. — (25).
Renner, Otto. — (40).
Reynolds, Mrs. J. C. — (12).
Reynolds, Mrs. L. R. — (4); — (31).
Ried, C. — (8).
Rixford, G. P. — (2).
Robbins, L. F. — (5).
Robbins, W. W. *2210, 2322* (42).
Roberts, Eva L. *934* (35).
Robinson, O. W. — (2).
Rock, J. F. — (33).
Rodde, Mrs. A. F. — (29); — (32); — (35).
Rollins, Reed C. *451, 1691, 2132* (35); *1393, 1813, 1853, 1883* (42).
Rollins, Reed C., & T. S. Chambers. *2591* (17).
Rolph, C. J. — (5).
Rose, Mrs. C. F. — (5); — (30).
Rose, Frank H. *491* (8a); *169, 484* (10).
Rose, Jessie P. *8* (6).
Rose, J. N. *165* (17); *2589* (55); *2949* (56).
Rose, J. N., & Joseph H. Painter. *6457, 6702, 6842, 7048, 7084* (50); *6621, 7381* (55); *7445* (56).
Rose, J. N., Joseph H. Painter & J. S. Rose. *8774, 9237, 9440, 9485* (50).
Rose, J. N., & J. S. Rose. *11492* (47).
Rose, Lewis S. *35214* (2); — (5); *34206* (12); *32386* (17); *33255* (32).
Roseberry, R. D. *150* (32).
Rosenbaum, Lewis C. — (7a).
Rothrock, J. T. *148* (42).
Rountree, Lester. — (23).
Rountree, Mrs. Lester. — (32); — (36); — (45).
Roush, Lucile. — (32).
Rusby, H. H. — (41).
Russell, Paul G., & Max J. Souviron. *33* (50).
Rust, Henry J. *894* (17).
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Accepted scientific names are in Roman type; synonyms, in *italics;* new names and new combinations, in **bold face** type.

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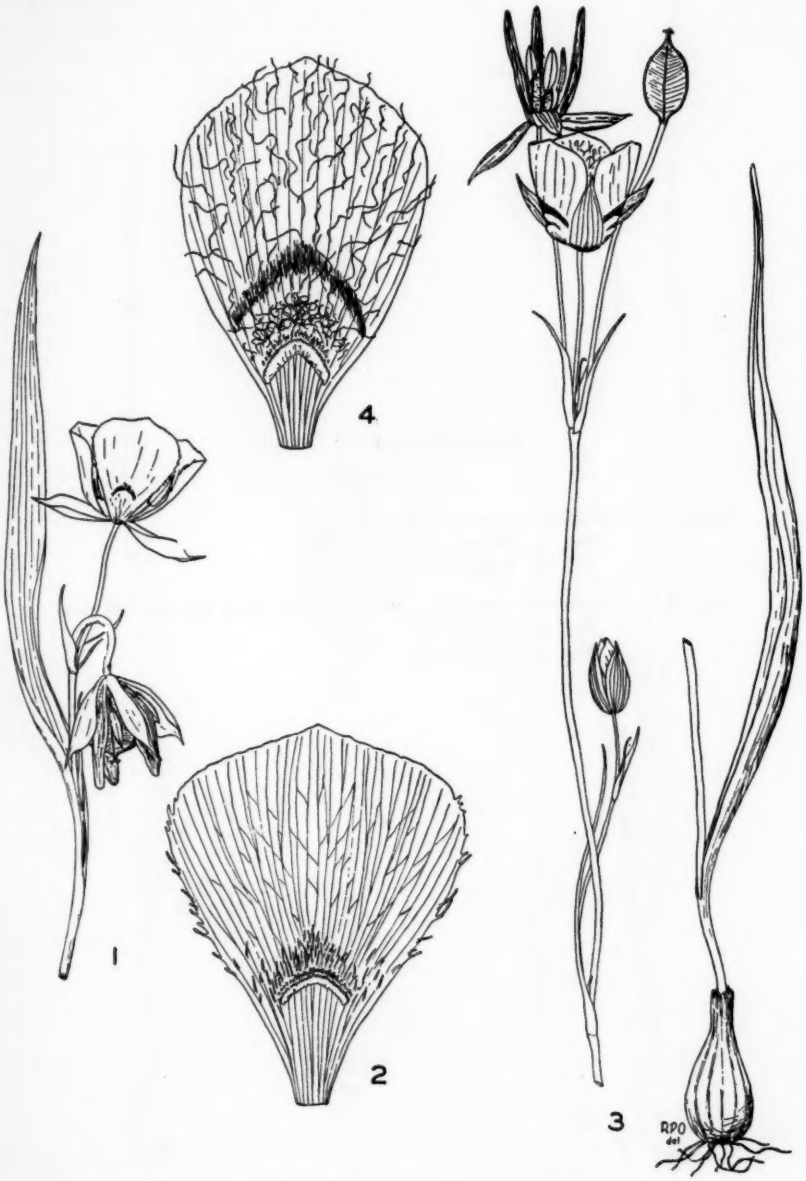
EXPLANATION OF PLATE

PLATE 38

Figs. 1–2. *Calochortus persistens* Ownbey. Drawn from the type collection.
Fig. 1. Habit, × ½.
Fig. 2. Petal, × 1½.

Figs. 3–4. *Calochortus Greenei* Watson
Fig. 3. Habit, × ½.
Fig. 4. Petal, × 1½.



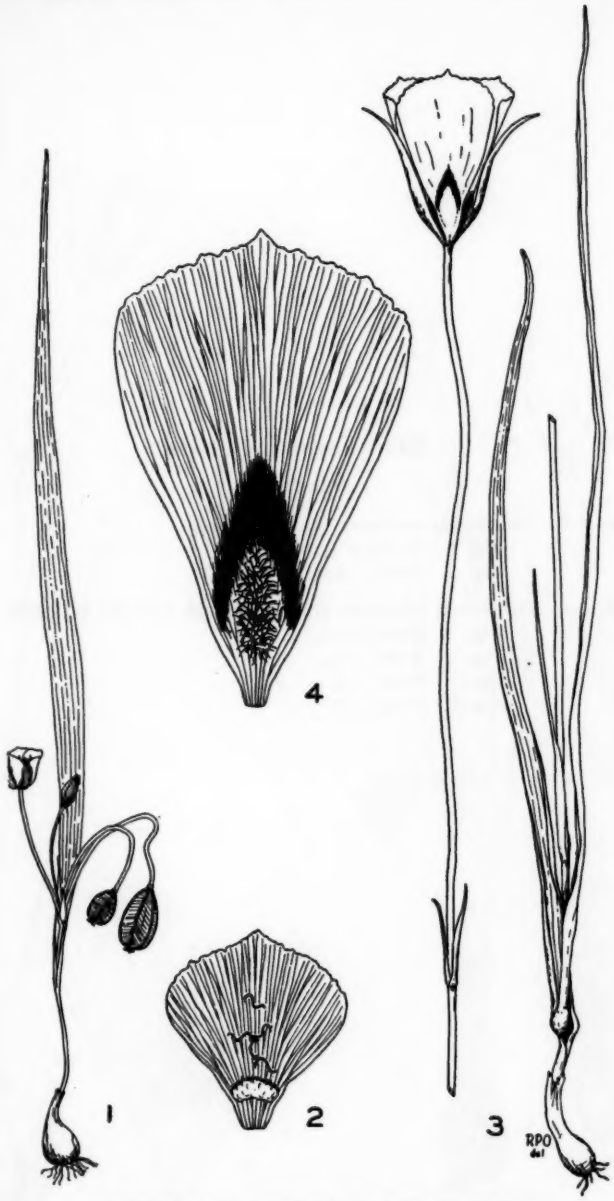
OWNBEY—MONOGRAPH OF CALOCHORTUS

Explanation of Plate

PLATE 39

Figs. 1–2. *Calochortus minimus* Ownbey
Fig. 1. Habit, × ½.
Fig. 2. Petal, × 2.

Figs. 3–4. *Calochortus monanthus* Ownbey. Drawn from the type collection.
Fig. 3. Habit, × ½.
Fig. 4. Petal, × 1½.



OWNBEY—MONOGRAPH OF CALOCHORTUS

Explanation of Plate

PLATE 40

Figs. 1–2. *Calochortus ambiguus* (Jones) Ownbey
Fig. 1. Habit, × ½.
Fig. 2. Base of petal, × 2½.

Figs. 3–6. *Calochortus nigrescens* Ownbey. Drawn from the type collection.
Fig. 3. Habit, × ½.
Fig. 4. Fruit, × ½.
Fig. 5. Sepal, × 2.
Fig. 6. Petal, × 2.

OWNBEY—MONOGRAPH OF CALOCHORTUS

EXPLANATION OF PLATE

PLATE 41

Calochortus foliosus Ownbey
Habit, × ½.

Drawn from the type specimen.

OWNBEY—MONOGRAPH OF CALOCHORTUS

OBSERVATIONS ON THE CULTURAL AND PATHOGENIC HABITS OF THIELAVIOPSIS BASICOLA (BERK. & BR.) FERRARIS

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Introduction

It is now common knowledge that many species of pathogenic fungi possess physiologic races that differ in one or more of such factors as cultural characters, morphology, pathogenicity, physiologic and ecologic relations, and biochemical effects.

Stakman ('36) has suggested four principal explanations of the origin of races of fungi: (1) adaptation of an existing form, (2) hybridization of two existing forms, (3) mutations, and (4) heterocaryosis. Although new forms may arise through adaptation these changes are usually more satisfactorily explained by other means. Many investigators have shown conclusively that new forms do arise from hybridization—especially well demonstrated in the Uredinales and Ustilaginales. There seems to be some conflict of evidence regarding the origin of new forms by heterocaryosis, but it must be conceded that this phenomenon would satisfactorily explain some of the sectoring that has occurred in cultures. Results of many experiments, notably by Stakman and his students, seem to prove that mutations do occur in fungi.

Results of investigations indicate that many physiologic races exist undiscovered today. Furthermore, considering the modes of origin of these races, it becomes painfully apparent that new forms are continually arising. Their importance can hardly be over-estimated. Any attempt to combat the ravages of a disease caused by such a variable fungus, in order to be successful, must be based on a comprehensive knowledge of the specialization or variation exhibited by the causal organism in various regions.

Thielaviopsis basicola (Berk. & Br.) Ferraris, until recently considered the imperfect form of *Thielavia basicola* Zopf, is known to attack a large number of plants ranging through several families, and to exist in widely separated regions of the world. An investigation of the fungus should be not only of scientific interest but should have an economic value as well, since it causes a root-rot of tobacco resulting in the loss of millions of dollars annually, seriously threatens other commercially important crops such as cotton and peanuts, and inflicts severe losses on violets, *Primula, Cyclamen,* and many of the Leguminosae. Before effective means of control of these diseases can be devised a more thorough knowledge of the variation of the causal organism is essential.

The purpose of this research was to study the variation in pathogenicity, morphology, and cultural characters of a few selected isolants of *Thielaviopsis basicola* as a basis for a more comprehensive study of the pathogen.

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THE HISTORY OF PHYSIOLOGIC SPECIALIZATION IN THIELAVIOPSIS BASICOLA

The literature pertaining to the existence of physiologic races of *Thielaviopsis basicola* is somewhat brief and scattered but it is interesting, nevertheless, in showing the general trend of thought on the subject.

Among the first to report on the existence of physiologic races of *Thielaviopsis basicola* was Rosenbaum ('12), who compared cultures of the fungus isolated from cotton, ginseng,

and tobacco, arriving at the conclusion that the forms isolated from the three different hosts were identical.

Taubenhaus ('14) secured pure cultures of *Thielaviopsis basicola* from cow-peas, violets, parsnips, and tobacco, and inoculated sweet-peas with them. At the same time he ran a parallel set of inoculations, using a culture obtained from sweet-peas. Since the fungus taken from hosts other than the sweet-pea would readily infect the latter, he regarded this as indicating the absence of physiologic races.

Johnson ('16) succeeded in infecting nearly one hundred species with *Thielaviopsis basicola* from tobacco and cites this as further evidence that no specialized races of the fungus appear to exist. Later, Johnson and Hartman ('19) state:

> It should be said that as far as evidence from literature, or as far as the observation of the writer is concerned, there is nothing to indicate that specialized races of *Thielaviopsis basicola* occur, or that the fungus varies in any way in virulence owing to differences in strains or age of culture. It may be said with considerable certainty, therefore, that we are dealing with a relatively constant organism as to pathogenicity.

Kletschetoff ('26) found that artificial inoculation of soil with *Thielaviopsis basicola* resulted in flax-sick soil. He did not consider the organism as a physiologic race because he was able to infect *Viola odorata, V. tricolor, Trifolium pratense,* and *Lupinus luteus* with it.

From the Kentucky Agriculture Experiment Station ('31) is sent the report that isolants of the black root-rot organism, *Thielaviopsis basicola,* from various sources and sometimes from the same source, varied markedly in morphological characters, including presence or absence of chlamydospores or endoconidia and in rate of growth. It has not been determined whether the differences observed represent permanent differences in the races.

Tiddens ('33) isolated two races of *Thielaviopsis basicola* from *Primula obconica,* one from tobacco, and one from poinsettia. Inoculations with these isolants showed that *Primula* was more seriously damaged by the races from *Primula* than by the race from tobacco, while that from poinsettia was less virulent to them than that from tobacco. Tobacco plants were

most seriously damaged by the isolant from tobacco, while the races from *Primula* were less virulent to them than that from poinsettia. Bean plants were more seriously damaged by the race from poinsettia than by that from tobacco, while races from *Primula* were less virulent to them than that from poinsettia.

Johnson and Valleau ('35), working with eleven cultures of *Thielaviopsis basicola* isolated from White Burley tobacco, found that they differ from one another when grown on potato-dextrose agar. Numerous sectors were formed when these cultures were transferred to this medium in Petri dishes after having grown a few weeks in test-tubes. Single endoconidium cultures of the original cultures differed from one another and were unstable. Further single-spore isolants of the single-spore cultures proved to be equally unstable. An albino culture and cultures producing only chlamydospores were among the variants. Eight single-spore cultures differing in appearance showed little variation in pathogenicity.

The occurrence of physiologic specialization within *Thielaviopsis basicola* was demonstrated by Sattler ('36) in inoculation experiments on tobacco, beans, and lupines. Working with collections of the fungus from the United States and Germany, he found that tobacco reacted positively only to American races isolated from tobacco, while the other two (except *Lupinus albus)* were infected by the bean *(Phaseolus multiflorus)* and *Cyclamen* races from Germany and by that from *Primula obconica* of Holland but not by the tobacco collection.

Berkner ('37), while studying the use of certain legumes in crop rotation in Silesia, noticed a severe attack of *Thielaviopsis basicola* on *Lupinus luteus* and observed that *Lupinus angustifolius,* field peas, and *Vicia villosa* were also affected. He indicated the existence of a physiologic race adapted to legumes and especially to *Lupinus luteus.*

Allison ('38) reports as follows:

> Seeds of various varieties of tobacco, including Burley and flue-cured types, were sown in flats containing soil artificially infected with single-spore cultures of *Thielaviopsis basicola.* Four definite physiologic races were determined on the basis of their pathogenicity on 4 tobacco varieties: Special 400,

Kentucky No. 5, Kentucky No. 16, and Harrow's Velvet. Kentucky No. 5 was moderately susceptible to race 1, while the other varieties were resistant. Kentucky No. 5 and Special 400 were moderately susceptible to race number 2, and Kentucky No. 16 and Harrow's Velvet were resistant. Kentucky No. 5 and Special 400 were susceptible, Kentucky No. 16 moderately susceptible, and Harrow's Velvet was resistant to race 3. Harrow's Velvet was moderately susceptible to race 4, while the other three varieties were susceptible. Races 1 and 2 were isolated from specimens of black root-rot obtained from Tennessee and North Carolina. Race 3 was isolated from material obtained from Tennessee and Washington, D. C. Race 4 was isolated from specimens sent from Wisconsin and Canada.

It would be an endless task to present the numerous publications dealing with the host range of *Thielaviopsis basicola*. The work of Johnson ('16) is outstanding in the presentation of a comprehensive list of all the hosts on which this fungus had been reported to occur, and includes a large number from his own observations. Since his work only a few additional hosts have been reported.

In summarized form it may be stated that the fungus has been found on 120 species in 30 families, distributed as follows: Leguminosae—43; Solanaceae—25; Cucurbitaceae—8; Compositae—5; Umbelliferae, Begoniaceae, Hydrophyllaceae, and Scrophulariaceae—each represented by 3 species; Cruciferae, Primulaceae, Chenopodiaceae, Violaceae, and Orchidaceae—2 species each; and Portulacaceae, Bignoniaceae, Oxalidaceae, Malvaceae, Araliaceae, Linaceae, Convolvulaceae, Polemoniaceae, Papaveraceae, Gesneriaceae, Liliaceae, Ranunculaceae, Oleaceae, Aquifoliaceae, Euphorbiaceae, Orobanchaceae, and Rosaceae—represented by one species each.

Materials and Methods

From a total of ten cultures of *Thielaviopsis basicola* received from various sources and isolated from several hosts, three were selected for study. Of these three, one was isolated from tobacco in Tennessee, one from cotton in Texas, and one from *Primula obconica* in Holland. For the sake of convenience, the isolant from tobacco has been assigned the letter A, that from *Primula* the letter B, and that from cotton the letter C. Single-spore cultures were made from each, and stock

cultures were prepared by mass transfers from the single-spore colonies. The single-spore colonies originated from endoconidia isolated according to the method suggested by Lambert ('39). All stock cultures were grown at room temperatures in test-tubes containing 10 cc. of Difco potato-dextrose agar with a pH of 5.6. Throughout the entire study of cultural behavior 20-cc. lots of media in 9-cm. Petri dishes were used.

In comparing the three races of *Thielaviopsis basicola* the author has used rather freely the patterns of frequency and growth curves as a basis. At first, this may seem like a rather obscure method of comparing racial characters but it reveals certain differences that could be noted in no other way. For example, in fig. 1 the various patterns of the growth curves represent clearly differences in behavior of races A, B, and C. Again, in fig. 9 the patterns of frequency curves of chlamydospore chain lengths reveal distinctive differences in behavior, as in race A, for instance, where a great majority of the spore chains fall in the class having a length of 31.35 μ and give the curve a high, narrow peak with very little spread. B, on the other hand, has the majority of its spore chains distributed through a range between 31.35 and 54.15 μ, creating an entirely different pattern with a much lower apex and a much wider spread. The fact that A produces chains largely of the same length while those formed by B vary greatly in length certainly forms the basis for a differential character between the two races which is well demonstrated by the patterns of the curves.

Variation in Culture

The three isolants of *Thielaviopsis basicola* were studied for variation in culture. Leonian's agar and onion agar were prepared after the recommendations of Riker and Riker ('36), and the acidity of each adjusted to a pH of 5.8. Difco potato-dextrose agar with a pH of 5.8 was also used. Each medium was made up in a single lot and all three were tubed, sterilized, and poured at the same time.

All Petri dishes were inoculated at the same time from stock

cultures of the same age, each culture originating from a single endospore. Six or seven cultures of each race were started on each of the three media, and an attempt was made to equalize the amount of inoculum used. The cultures were incubated in a glass case at room temperatures ranging from 21° to 29° C., and observed for fifteen days. The positions of the cultures within the cases were frequently shifted in order to reduce the possibility of exposure to slightly different environmental conditions.

Room conditions were so variable over a period of five months that it was impossible to duplicate results exactly despite the fact that four different sets of cultures were observed. On each medium the individual colonies of each race were similar within a set but different between sets. In other words, in race C a group of cultures on potato-dextrose agar observed February 12 differed from a set observed November 15. This variation between sets was probably due, to a small extent, to variation of culture media, since the media were made up in separate lots for each set. Cultures kept in incubation chambers under constant conditions failed to show a marked variation from set to set. For this reason the variation exhibited between sets started at different dates was attributed largely to variable room conditions. The races were compared under room conditions, in preference to the constant conditions of an incubator, because the variable environmental factors brought out more striking differences.

Race C was found to vary more than the other two races between sets of cultures observed November 15, February 12, and March 8, exhibiting a wide range of color, zonation, sectoring, and type of mycelial growth. This would seem to indicate that race C is more reactive to environment than either of the other races, but it is probable that its inherent instability is in part responsible for the variation. Race A was very constant between sets, showing slight variation in any respect, while B was intermediate in variability.

Considering a single set of cultures, however, the variation among the colonies of a race on the same medium was surprisingly small, as shown by plates 42 and 43. Again race C showed

the most variation in color, zonation, sectoring, and type of mycelial growth. In this case it seems that the slight variation must be due to the relative instability of the race. The colonies of A were practically alike while race B showed very slight variation.

In table 1 are summarized the cultural characteristics of races A, B, and C. The data were taken fifteen days after inoculation, with the exception of the diameters of the colonies. The latter were recorded at the end of twelve days because of difficulty in securing accurate measurements beyond this period—a difficulty due to uneven growth of the edges of the colonies.

Unfortunately, photographs of the cultures employed in securing data were faulty, except those on Leonian's agar. Photographs of cultures on onion and potato-dextrose agars at the age of nine days have been substituted, so there may be slight discrepancies between the photographs and the descriptions of table 1.

The data included in table 1, combined with the photographs, can leave little doubt that the three races are culturally distinct. One of the characters serving best to differentiate the three isolants is zonation. Regardless of the medium, race A shows only a very faint or no zonation. When this character is noticeable in cultures of A it is usually due to a single band of scanty, more or less appressed mycelium which may or may not differ slightly in shade of color. Race B shows definite zonation which varies from 5 to 10 bands generally ranging through several shades of gray. Race C produces the most striking zonation, 5 to 15 zones distinguished by various colors, usually some shade of gray, and by a difference in the compactness of the mycelium.

Race C is further distinguished by the production of white V-shaped sectors, usually more or less appressed and farinose, rarely felty. Their frequency varies with the medium employed. On potato-dextrose agar sectors appear occasionally; on Leonian's agar they are more frequent; and on onion agar there are several sectors in each colony, giving a somewhat star-shaped appearance (pl. 42). Sometimes these sectors are

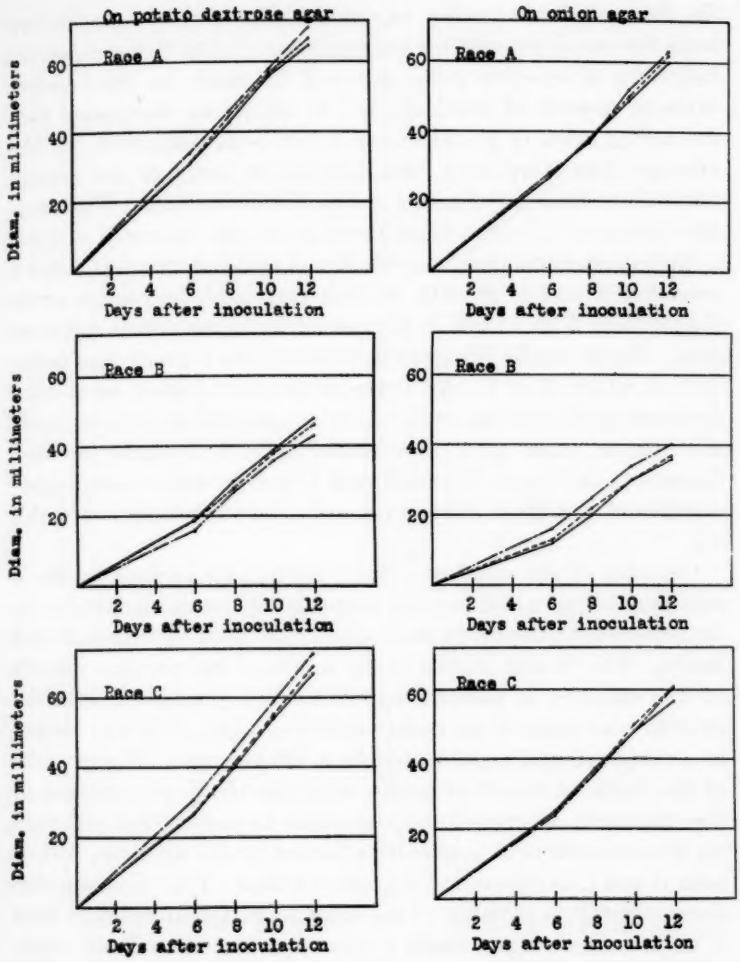


Fig. 1. Growth curves of races A, B, and C on potato-dextrose and onion agars. Growth of three colonies of each race plotted separately.

quite large, occupying as much as half the area of a colony. The stability of the sectors has not yet been established.

Most of the data used so far to differentiate the races have been purely of a qualitative nature. The average diameters of

the three isolants on the various media form a quantitative basis for some interesting comparisons. Often throughout the following discussion reference will be made to the relative rates of growth of the isolants. It should be mentioned that the actual rates of growth have never been computed, but the average diameters have been used as an index of the growth rates since they are directly proportional to them. The average diameters 12 days after inoculation are recorded in table I. Reference to this table and to figs. 1 and 2 shows that A has a more rapid rate of growth on both Leonian's and onion agars than either B or C but is surpassed by C on potato-dextrose agar. On all media the growth rate of C is a great deal below that of either A or C. All three races grow fastest on potato-dextrose agar, slowest on Leonian's agar, and at an intermediate rate on onion agar. Statistically, the differences between diameters in A and B and B and C are in every case highly significant but those between A and C are much less so (table II).

Colonies of the same race were studied on various media in an effort to find a differential response of the races. Evidently there was a variation in their ability to grow on the different media. This is best shown in fig. 4, where the average growth of five colonies is considered. Since the greatest amount of growth was secured on potato-dextrose agar, this was chosen as a standard and represented by a 100 per cent. The growths of the races on the other media were plotted in percentages of the standard. It immediately becomes apparent that although the growth rate of A is greatly affected by the medium, that of both B and C is affected to a greater extent. This diagram also shows that B is capable of growing to better advantage than C on Leonian's agar while C grows better than B on onion agar.

A study of the growth curves in figs. 1 and 2 reveals certain differences in the behavior of the three races. In each case the diameters of three colonies are plotted separately to give an idea of the variation within the race. On potato-dextrose one immediately notices that not only do the colonies of the three races differ in size but that there are distinct differences in the

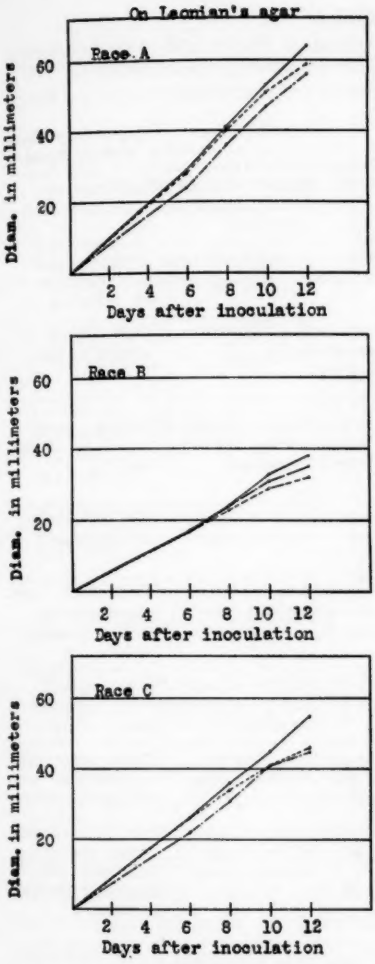


Fig. 2. Growth curves of races A, B, and C on Leonian's agar. Growth of three colonies of each race plotted separately.

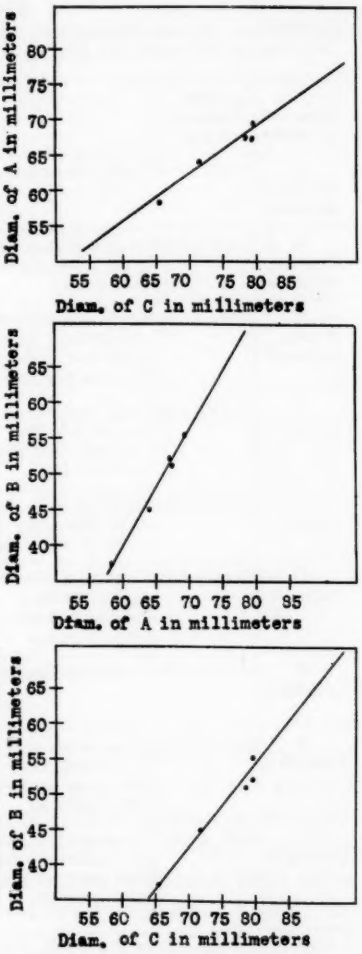


Fig. 3. Relative influence of hydrogen-ion concentration on growth of races A, B, and C. Explanation in text.

patterns of the growth curves. Eight to ten days after inoculation growth-inhibiting factors of some kind seem to be affecting the growth of B. In race C these factors have not made

TABLE I

CULTURAL CHARACTERISTICS OF THREE RACES OF *THIELAVIOPSIS BASICOLA* ON VARIOUS MEDIA FIFTEEN DAYS AFTER INOCULATION

Race and Medium	Diam. colonies in mm.*	Color †	Zonation	Type of mycelium and sectoring
A Potato-dextrose	67.33 ± 0.45	Light cinnamon-drab	Slight—1 band of scanty, appressed mycelium	Cottony, farinose; no sectoring
B Potato-dextrose	45.29 ± 0.48	Predominately gull-gray, some zones a light mouse-gray	5 to 7 faint zones of varying color	Cottony, outer part farinose; no sectoring
C Potato-dextrose	69.43 ± 0.49	From vinaceous-fawn in the center to pale mouse-gray and neutral gray in outer portions	5 to 7 pronounced zones	Felty, white V-shaped sectors
A Onion	62.17 ± 0.61	From dusky drab in center to blackish brown (3) and dark olive-gray on outer edge	Slight—1 band of scanty, appressed mycelium	Cottony, farinose; no sectoring
B Onion	37.16 ± 0.53	Mouse-gray in center to light olive-gray and white at outer edge	7 to 8 zones of varying color	Felty, farinose; no sectoring
C Onion	59.5 ± 0.65	From cinnamon-drab in center to deep neutral gray and mouse-gray in outer portions	8 to 10 zones of varying color	Part felty, part appressed and farinose; many sectors
A Leonian's	60.44 ± 0.7	Vinaceous-fawn	Slight—1 band of scanty, appressed mycelium	Cottony, farinose; no sectoring
B Leonian's	34.86 ± 0.5	From mouse-gray in center to deep neutral gray and pale gull-gray in outer portions	8 to 10 pronounced zones	Felty, outer part farinose; no sectoring
C Leonian's	48.0 ± 1.04	Mouse-gray in center, predominately olive-gray and gull-gray in outer portions	10 to 15 pronounced zones	Felty, portions appressed and farinose; several sectors

* Average diameters of five colonies 12 days after inoculation.

† Colors according to Ridgway's "Color Standards and Color Nomenclature." 1912.

their appearance by the end of twelve days but in race A they may be observed from ten to twelve days after inoculation. Apparently A is able to grow faster than C for a few days following inoculation but by the end of twelve days the diameters of colonies of C surpass those of A, due partially to

TABLE II

SUMMARY OF STATISTICAL DIFFERENCES IN DIAMETERS OF THREE RACES OF *THIELAVIOPSIS BASICOLA* ON VARIOUS MEDIA

Comparisons	Medium	Differences, in mm.	Difference divided by probable error
A and B	Potato-dextrose	22.04 ± 0.66	33.4
A and C	Potato-dextrose	2.1 ± 0.66	3.2
B and C	Potato-dextrose	24.14 ± 0.68	35.5
A and B	Onion	25.01 ± 0.82	30.5
A and C	Onion	2.67 ± 0.89	3.0
B and C	Onion	22.34 ± 0.84	26.6
A and B	Leonian's	25.58 ± 0.86	29.7
A and C	Leonian's	12.44 ± 1.25	9.9
B and C	Leonian's	13.14 ± 1.15	11.4
$A_{p.d.}$ and A_o*		5.16 ± 0.19	27.2
$B_{p.d.}$ and B_o		8.13 ± 0.18	45.2
$C_{p.d.}$ and C_o		9.93 ± 0.18	55.2
$A_{p.d.}$ and A_L		6.89 ± 0.84	8.2
$B_{p.d.}$ and B_L		10.43 ± 0.69	15.1
$C_{p.d.}$ and C_L		21.43 ± 1.14	18.8
A_o and A_L		1.73 ± 0.93	1.9
B_o and B_L		2.3 ± 0.73	3.2
C_o and C_L		11.5 ± 1.22	9.4

* $A_{p.d.}$, $B_{p.d.}$, $C_{p.d.}$—A, B, and C on potato-dextrose agar.
A_o, B_o, C_o—A, B, and C on onion agar.
A_L, B_L, C_L—A, B, and C on Leonian's agar.

an increase in C's rate of growth and partially to growth-inhibiting factors affecting A. A comparison of the growth curves of the isolants on Leonian's agar will show similar differences in pattern. Here, growth-inhibiting factors are definitely affecting both B and C from ten to twelve days after inoculation while A is influenced very slightly. Again, the colonies of A on onion agar grow much more rapidly than C immediately after inoculation but C later exceeds A in rate of growth. The term "growth-inhibiting factors" has been used rather loosely to designate any factors of the fungus, medium, or environment that tends to reduce the rate of growth. It should be remembered, however, that in each set of experiments the fungus is theoretically the only variable.

The fact that varying hydrogen-ion concentrations generally

affect the virulence of *Thielaviopsis basicola* suggested that the three races studied might respond differently. Since the time and facilities for a study of the effect of hydrogen-ion concentration on the virulence of the fungus were lacking, observations were made of its effect on the races in culture. For this experiment Difco potato-dextrose agar was made up in a single lot and the acidity of portions adjusted to pH 4,5,6,7, and 8, respectively. Cultures of all three races were made at each of the pH values and incubated at 20° C. Observations were made for eleven days. There were very slight changes in appearance of the colonies at different acidities—so slight that no attempt was made to record them. The rates of growth showed a greater variation and were easily measured as expressed by the average diameters of the colonies at the end of eleven days. This data is recorded in table III.

In all cases the rates of growth were more influenced by the changes from pH 4 to 6 than from 6 to 8. Oddly enough, the growth rates continued to increase up to pH 8, or at least the diameters of all the colonies observed were greatest at this concentration. A pH of 8 had been considered above the optimum for growth but unfortunately the results fail to show the

TABLE III

RELATIVE EFFECT OF pH ON DIAMETERS OF COLONIES AND PRODUCTION OF CHLAMYDOSPORES OF RACES OF *THIELAVIOPSIS BASICOLA*

Race	pH	Average diameters in mm. of five colonies	Relative production of chlamydospores
A	4	58.3 ± 0.23	Medium
A	5	64.0 ± 0.24	Heavy
A	6	67.5 ± 0.15	Heavy–
A	7	67.2 ± 0.32	Light+
A	8	69.6 ± 0.20	Light
B	4	37.2 ± 0.68	Heavy
B	5	45.0 ± 0.43	Medium+
B	6	51.2 ± 0.53	Heavy
B	7	52.4 ± 0.63	Heavy
B	8	55.6 ± 0.27	Heavy
C	4	65.7 ± 0.23	Light–
C	5	71.7 ± 0.60	Light–
C	6	78.6 ± 0.66	Light
C	7	79.3 ± 0.50	Light
C	8	79.4 ± 0.40	Light

expected decrease in rate of growth on the basic end of the scale. As originally planned, this experiment would have shown the relative inhibiting action of less favorable hydrogen-ion concentration on each side of an optimum.

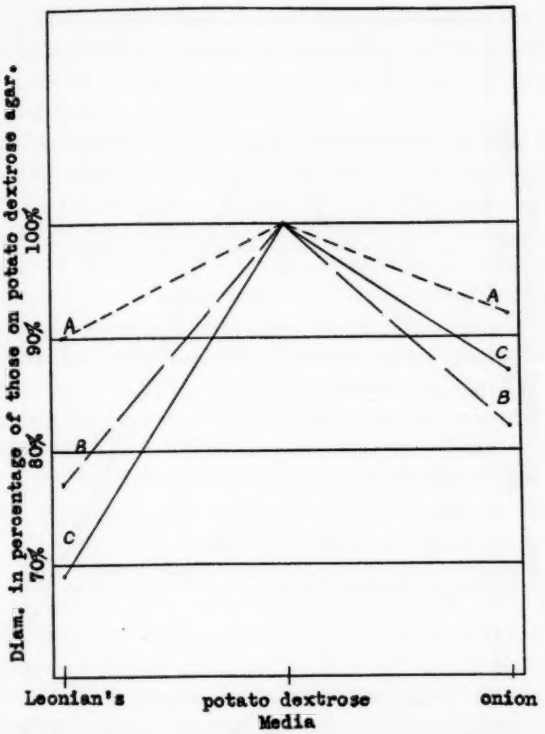


Fig. 4. Relative influence of media on the growth of races A, B, and C. Based on averages of five colonies of each race.

In order to get an idea of the relative effect of hydrogen-ion concentration on the three races the average diameters of one race were plotted against those of each of the other two as shown in fig. 3. For instance, in one graph the average diameter of five colonies of A at pH 4 were plotted against the average diameter of five colonies of race C at a pH of 4,

and so on up the scale to a pH of 8. In another graph, A was plotted against B and in a third B was plotted against C. If the two races compared were equally affected the line formed by plotting their average diameters should form angles of 45° with the abscissa and ordinate. If, however, the two races

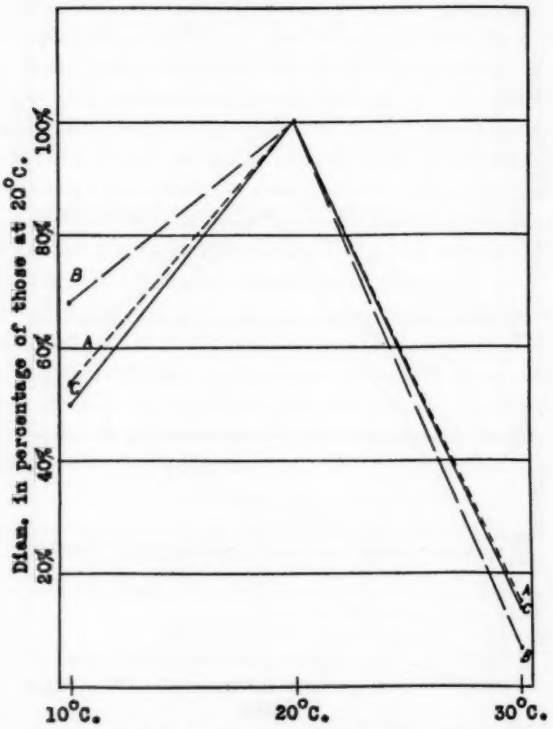


Fig. 5. Relative influence of temperature on the growth of races A, B, and C. Based on averages of five colonies of each race.

are unequally affected, as for example are A and B, the angles will differ. Since B is affected to a greater extent than A and since B is recorded on the axis of the ordinates the angles between the ordinate and the plotted line is less than 45°. In comparing the three races B was found to be most reactive to a variation in pH while race A was least affected.

A slight variation in the shade of color exhibited by race A on media of different pH suggested that perhaps the development of chlamydospores was influenced by these changes in hydrogen-ion concentration. An examination of the cultures showed a striking variation in chlamydospore formation (table III). Race A was greatly influenced by changes in hydrogen-ion concentration—spore production being greatly retarded by lower concentrations—while B and C were not noticeably affected.

In order to study the effect of temperature on the rate of growth, cultures of each race of *Thielaviopsis basicola* were incubated at 10° C., 20° C., and 30° C. The cultures were made following the usual procedure, on potato-dextrose agar with a pH of 5.6. The average diameters at the end of twelve days are recorded in table IV. Fig. 5 shows more plainly the variation in response to temperature. Since 20° C. is probably nearest the optimum for all three races, growth at that temperature was selected for a standard. As in fig. 4, this growth is considered a 100 per cent and the growth at the other temperatures plotted as percentages of the standard. From this diagram one can see that a change from 20° C. to 10° C. affects all races much less than a change from 20° C. to 30° C. Race B is least affected of the three by a change to 10° C. and most greatly influenced by a change to 30° C. while A is slightly less affected in both cases than C. The one outstanding variation shown here, and perhaps the only significant one, was the behavior of B at 10° C. It would seem to indicate that B is relatively better adapted to growth at lower temperatures than are A and C. Chlamydospore pro-

TABLE IV

AVERAGE DIAMETERS* OF RACES OF *THIELAVOPSIS BASICOLA* AT VARIOUS TEMPERATURES TWELVE DAYS AFTER INOCULATION

Race	10° C.	20° C.	30° C.
A	40.5 mm.	75.3 mm.	10.8 mm.
B	33.2 mm.	48.8 mm.	3.3 mm.
C	41.8 mm.	83.2 mm.	12.2 mm.

* Average diameters of five colonies.

duction was found to be about the same at 10° C. and 20° C., decreasing at 30° C. This tendency extended throughout all three races and failed to disclose any differential reactions.

MORPHOLOGICAL COMPARISONS

Before entering into a comparison of the morphological characters of the three races of *Thielaviopsis basicola* perhaps it would be wise to give a brief description of the fungus.

Thielaviopsis basicola (Berk. & Br.) Ferraris, in the light of information furnished by McCormick ('25), is generally considered a member of the Fungi Imperfecti. More specifically, the fungus is classified under the Amerosporeae in the Dematiaceae. The mycelium of the fungus is made up of septate hyphae, variously branched, whose diameters range from 3 to 7 μ. The hyphae are hyaline when young but may become brown with age. The amount of protoplasm seems to decrease with age, and often the walls of the older hyphae are more or less collapsed.

Two very characteristic spore forms are produced by this fungus. The first to appear are the endoconidia which are formed by hyaline branches of the mycelium known as endoconidiophores. These endoconidiophores are phialides consisting of a bulbous base ranging from 5 to 10 μ in diameter, and an elongate barrel 50 to 90 μ in length, gradually tapering to a diameter of from 3 to 7 μ. They arise as small protrusions from near the center of a hyphal cell into which a nucleus migrates after a division of the single parent-cell nucleus (Brierley, '15). The endoconidiophore is soon cut off from the vegetative hyphae by a cross-wall. Within the barrel of the endoconidiophore are successively formed a number of hyaline endoconidia whose walls result from a tangential splitting of the walls of the barrel and from the laying down of a transverse wall at the lower end. The end of the sheath is ruptured with the production of the first conidium and a chain of spores is gradually extruded. The endoconidia vary greatly in size—from 3 to 6 μ in width and from 8 to 30 μ in length. The hyaline spores have a single nucleus and usually two vacuoles and are capable of germinating immediately

to form a new mycelium. Although this spore form is exceedingly abundant in culture it was seldom noticed on the host plants.

The chlamydospores seem to grow from any part of the mycelium and may occur in clusters composed of many chains, whorls of two or three chains, or in single chains. They may be borne laterally or terminally on the hyphae. The chains are composed of three to nine spores, some of which are thick-walled and brown but one or more basal spores may be thin-walled and hyaline. Occasionally, these hyaline spores are not basally located. At maturity the spores tend to break apart and each is capable of germinating into a new mycelium. They are well adapted as resting spores and are thought to function in that capacity. They are abundant on the lesions produced on the various host plants. According to Brierley ('15), the chlamydospores are formed successively in the development of a hypha of limited growth.

The fact that the three races of *Thielaviopsis basicola* differed so distinctly in culture encouraged the belief that minor morphological differences might exist. Preliminary observations indicated that the endoconidia, endoconidiophores, and the chains of chlamydospores would lend themselves very well to measurement. Temporary slides were made from each race by mounting samples in lacto-phenol. Four samples of each

TABLE V

SUMMARY OF LENGTH AND WIDTH OF ENDOSPORES OF THREE RACES OF *THIELAVIOPSIS BASICOLA*

Race	Number spores measured	Length in microns		Width in microns	
		Mean	Range	Mean	Range
On potato-dextrose					
A	100	11.86 ± 0.19	7.6–22.8	4.15 ± 0.03	3.33–5.7
B	100	15.64 ± 0.23	7.6–28.5	4.72 ± 0.55	3.33–5.7
C	100	13.91 ± 0.25	7.6–28.5	4.32 ± 0.04	3.8 –5.7
On onion agar					
A	100	11.74 ± 0.11	7.6–17.1	4.09 ± 0.02	3.33–4.75
B	100	14.74 ± 0.18	7.6–24.7	4.45 ± 0.03	3.33–5.7
C	100	14.21 ± 0.22	7.6–24.7	4.41 ± 0.04	3.33–5.7

race from approximately the same position in different colonies were taken when the cultures were fifteen days old. Observations were made on cultures grown on potato-dextrose agar.

In table v are recorded the results of observations on the length and width of endospores. The endospores produced by race B are longer than those produced by C, and those of C are longer than those from A. The three races range within approximately the same limits with the exception of the upper limit of endospore length shown by race A. Race B produces the widest endospores and A the narrowest.

Table vi indicates that all of the differences in length and width of endospores are statistically significant with the exception of those between B and C on onion agar. It was thought that the kind of medium employed would have a great effect on the size of spores produced. However, a glance at table vi will show that the differences in spore size between colonies of the same race on different media are statistically insignificant, with the exception of race B on potato-dextrose and onion agars.

TABLE VI

SUMMARY OF STATISTICAL DIFFERENCES IN RELATIVE LENGTH AND WIDTH OF ENDOSPORES OF THREE RACES OF *THIELAVIOPSIS BASICOLA*

Races compared	Differences		Differences between means divided by probable error of differences	
	Length μ	Width μ	Length μ	Width μ
On potato-dextrose				
A & B	3.78 ± 0.29	0.57 ± 0.05	13.0	11.4
A & C	2.05 ± 0.32	0.17 ± 0.05	6.4	3.4
B & C	1.73 ± 0.34	0.4 ± 0.06	5.1	6.7
On onion agar				
A & B	3.0 ± 0.21	0.36 ± 0.04	14.3	9.0
A & C	2.47 ± 0.25	0.32 ± 0.04	9.9	8.0
B & C	0.53 ± 0.28	0.04 ± 0.05	1.9	0.8
A_{pd} & A_o*	0.12 ± 0.22	0.06 ± 0.04	0.55	1.5
B_{pd} & B_o	0.9 ± 0.29	0.27 ± 0.05	3.1	5.4
C_{pd} & C_o	0.3 ± 0.34	0.09 ± 0.06	0.88	1.5

* A_{pd}, B_{pd}, C_{pd}—A, B, and C on potato-dextrose agar.
A_o, B_o, C_o—A, B, and C on onion agar.

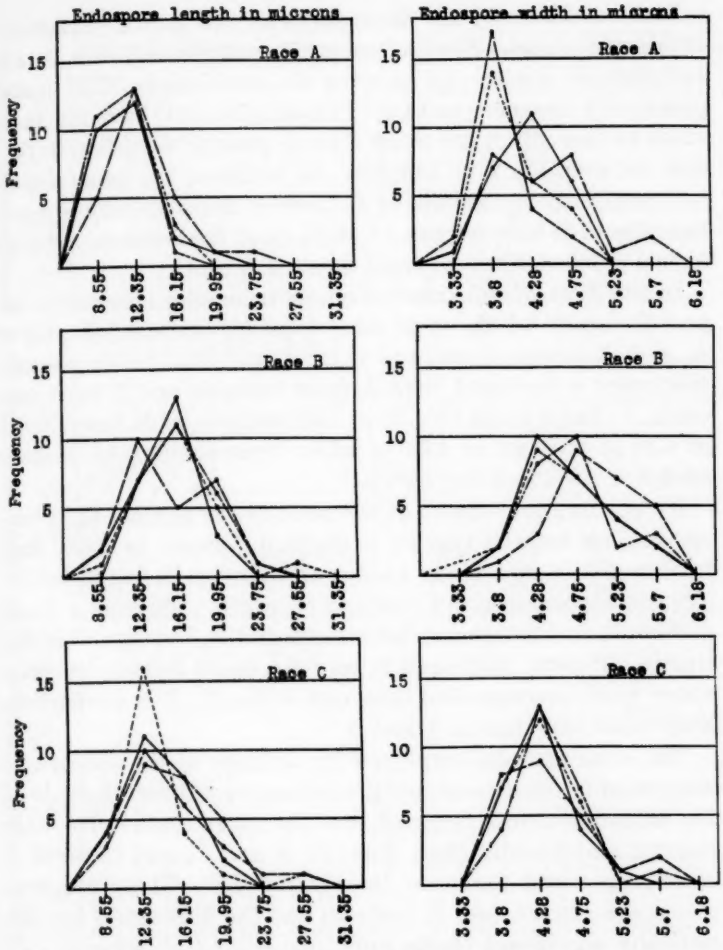


Fig. 6. Frequency curves of endospore lengths and widths of races A, B, and C on potato-dextrose agar. Samples from 4 colonies, each of 25 measurements, were plotted separately in each graph.

In fig. 6 are plotted frequency curves of the endospore length and width on potato-dextrose agar. Four samples of twenty-five measurements each are plotted separately for each race, each sample being taken from a separate colony. The most conspicuous features of these graphs are the distinct differences

in pattern shown by the three races as well as the variability within the races. For instance, the samples of race A are surprisingly similar, all showing the same mode, 12.35 μ, and practically the same pattern. The samples of C have the same mode as those of A but show a much greater variation in pattern between the four samples. In addition, the general pattern exhibited by samples of C shows a much greater spread. Samples of B have a mode of 16.15 μ and the frequency curves have a pattern different from those of A and C.

In the light of information on spore lengths one would expect the spore widths to be most constant between samples of A, with B intermediate, and C most variable. Oddly enough, this order is reversed, with A most variable and C most constant. C has a mode of 4.28 μ; two samples of B have modes of 4.28 μ, and two of 4.75 μ; while three samples of A show modes of 3.8 μ, and one, 4.28 μ.

By plotting the widths of the endospores against their corresponding lengths (fig. 7) a slight difference in trend may be detected in race C. In race A an increase in length is usually accompanied by an increase in width. There is a slight difference in this respect between A and B, but race C is distinctly different. Although in race C a small increase in endospore width accompanied increases in length, it is proportionately much less than in A and B.

The same samples employed for a study of the endospores were used in the measurement of chlamydospores. A study of the chlamydospores revealed that the spore chains of A were shorter and broader than those of B and C, and those of B were longer and narrower than those of C. These measurements are summarized in table VII and the differences are statistically significant (table VIII).

The arrangement of the spore chains on the hyphae varied with the races but it was not a character lending itself easily to quantitative measurement. It may be stated, however, that in race A the chains were often in large conspicuous clusters. In race B the number of chains in a group usually ranged from one to three and in C seldom more than one chain arose from a point on the hypha (pl. 44).

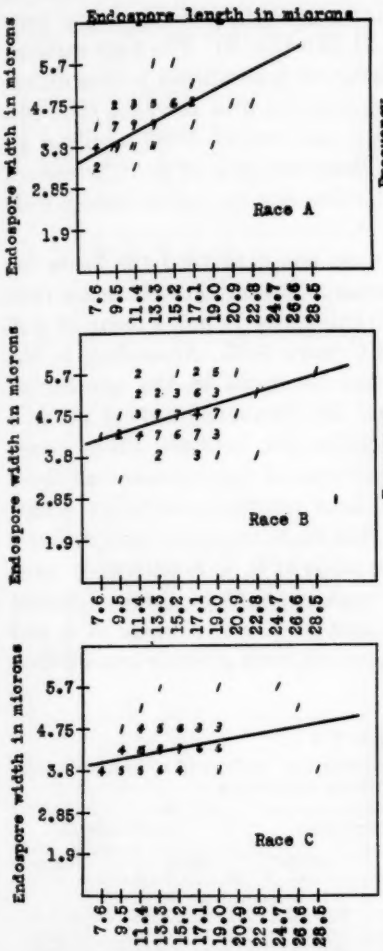


Fig. 7. Relation of endospore length and width of races A, B, and C. Based on 100 spore measurements.

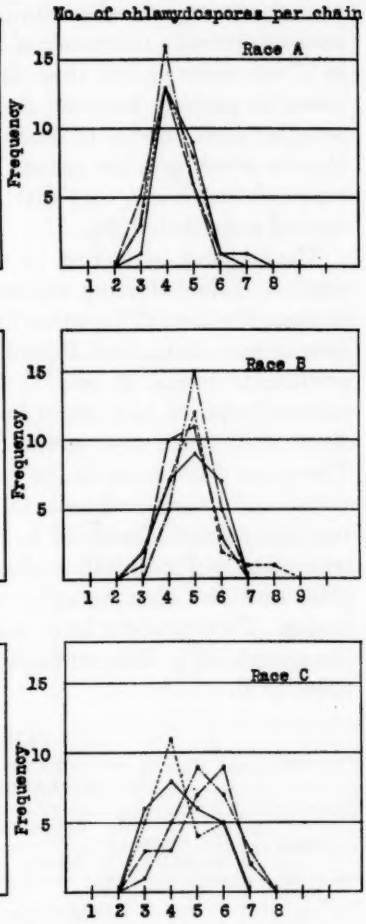


Fig. 8. Frequency curves of the number of chlamydospores per chain for races A, B, and C. Samples of 25 measurements from four different colors are plotted separately.

The frequency curves of chlamydospore chain lengths of race A are remarkably similar in pattern, all having a very narrow spread and a mode of 31.35 μ (fig. 9). The four samples of C are more varied than those of A as shown by the differences in pattern between the samples and the fact that two samples have modes of 31.35 μ and two of 38.95 μ. They all show a much greater spread than samples of A. The curves representing B are very distinctive due to the extremely wide spread near their tops.

The number of spores in each chain formed the basis for another differentiating character. The arithmetic mean fails to show the true differences in this case. A has a mean of 4.26 spores per chain, and B and C have 4.83. According to the arithmetic mean, B and C are identical in the number of chlamydospores in a chain but the frequency curves in fig. 8 show that there is a great difference between these races. There are differences in the patterns of the curves of all three races. A is very constant, all four samples exhibiting a narrow spread and a mode of 4. B is more variable than A, has a somewhat wider spread, and a mode of 5. C is extremely variable, and the four samples measured have three different modes. Two samples have modes of 4, one a mode of 5, and one a mode of 6. The curves show an even greater spread than those of B.

TABLE VII

LENGTH AND WIDTH OF CHLAMYDOSPORE CHAINS OF THREE RACES OF *THIELAVIOPSIS BASICOLA*

Race	No. chains measured	Length in microns		Width in microns	
		Mean	Range	Mean	Range
A	100	32.36 ± 0.31	20.9–55.1	11.86 ± 0.03	9.5–13.3
B	100	43.93 ± 0.23	24.7–74.1	10.1 ± 0.07	7.6–11.4
C	100	36.1 ± 0.56	22.8–60.8	11.04 ± 0.05	9.5–15.2

The actual lengths of individual chlamydospores were not measured but they were computed for each sample of the three races by dividing the lengths of the chains by the number of spores per chain. This is not a perfect measurement due to

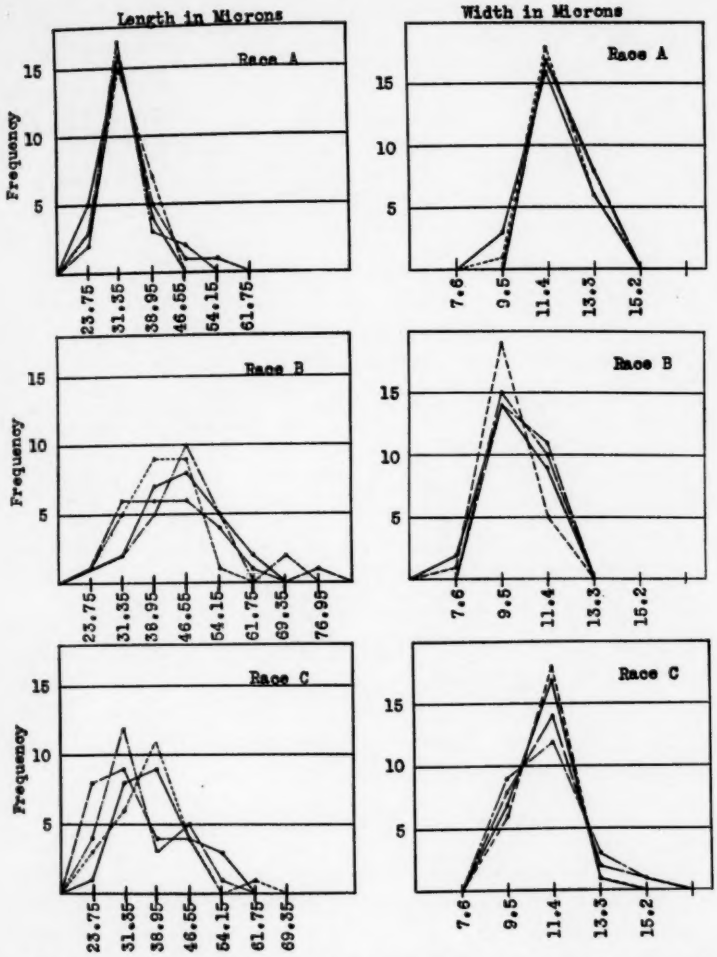


Fig. 9. Frequency curves of length and width of chlamydospore chains for three races of *Thielaviopsis basicola*. Samples of 25 measurements from 4 different colonies are plotted separately.

variation of spore length within a chain, but it will give the correct arithmetic mean (table IX).

Apparently the individual spores of B were longer than those of A or C, and those of A were slightly longer than those

TABLE VIII

SUMMARY OF STATISTICAL DIFFERENCES IN CHLAMYDOSPORE CHAIN LENGTH AND WIDTH

Races compared	Differences		Differences between means divided by probable error of differences	
	Length	Width	Length	Width
A & B	11.57 ± 0.46	1.76 ± 0.08	25.2	22.0
A & C	3.74 ± 0.64	0.82 ± 0.06	5.8	13.7
B & C	7.83 ± 0.61	0.94 ± 0.09	12.8	10.4

TABLE IX

LENGTH OF CHLAMYDOSPORES OF RACES A, B, AND C

Race	Sample * 1	Sample 2	Sample 3	Sample 4	Means of all four samples
A	7.41 μ	7.6 μ	7.41 μ	7.98 μ	7.6 μ
B	8.93 μ	9.12 μ	9.31 μ	8.74 μ	9.03 μ
C	7.98 μ	7.41 μ	7.6 μ	7.03 μ	7.51 μ

* 25 measurements in each sample.

of C. The longer chain length of B is primarily due to longer individual spores rather than to the number of spores in a chain since C and B have the same arithmetic mean for number of spores per chain. The chain length of C exceeds that of A, largely because C has more spores per chain than A though the individual spores of A are slightly longer.

VARIATION IN PATHOGENICITY

In order to determine if there were any variations in pathogenicity of the three races of *Thielaviopsis basicola,* inoculation experiments were carried on in the greenhouse. Wooden flats, 8″ × 11″, were filled with soil composed of two parts garden loam and one part peat moss. The soil was sterilized and its acidity adjusted to approximately pH 7 by the addition of lime.

On October 24 seeds of cotton, tobacco (Kentucky White Burley), *Primula obconica,* peanuts, and watermelons were planted—four flats of each plant (Series I). On October 29,

five days after planting, three flats of each plant were inoculated with races A, B, and C, respectively, and the fourth flat was reserved for a control. The flats were inoculated by watering with 200 cc. of a heavy fungal suspension which had been prepared by mixing thoroughly the contents of eight test-tubes of each race—all ten days old and on 10 cc. of potato-dextrose agar—with 1000 cc. of distilled water. The inoculum thus contained both endoconidia and chlamydospores, along with mycelium, and was probably greatly in excess of the amount necessary to insure infection.

A second set of inoculation experiments was set up on December 2 (Series II), differing from the first in the kind of soil and containers used. The soil was composed of a mixture of equal parts of garden loam, sand, and peat moss and was placed in 7″ pots. Lime was added to secure an approximate pH of 7. The plants were inoculated in the same manner as those in the flats.

It was impossible under the experimental conditions to regulate the soil temperature. During the latter part of October and the first part of November it ran somewhat higher than the accepted optimum for the development of *Thielaviopsis basicola*. Primarily for this reason the second set of host plants was installed early in December.

Periodical examinations indicated that the relative pathogenicity of the races could have been established four or five weeks after inoculation but a careful analysis of Series I was delayed until January 30—approximately twelve weeks after inoculation. Series II was examined February 10, about ten weeks after inoculation.

In determining the relative pathogenicity of each race on the various hosts, the extent of damage to the plant as a whole was stressed, along with the size and number of lesions. Microscopical examinations of the roots and stem bases were made. Specimens of each kind of plant were selected as standards for scoring the amount of injury. Heavy infection causing severe stunting and even death in some cases, along with large conspicuous lesions, was assigned a numerical value of 8; an intermediate degree of infection causing a slight stunting but with

plainly visible lesions was given a value of 5; slight infection causing hardly discernible damage and very small lesions was represented by the number 2; and those plants which failed to show any lesions, even under microscopical examinations, were scored 0. Slight variations from these standards were scored with intermediate numbers.

The whole series of numbers was assigned as follows:

No infection	0	Medium	5
Slight–	1	Medium+	6
Slight	2	Heavy–	7
Slight+	3	Heavy	8
Medium–	4	Heavy+	9

The results of the examinations are summarized in table x and shown in graphical form in fig. 10.

These experiments indicate that there is a decided difference in the ability of the three races to parasitize various hosts. Throughout the whole series race C is a very weak parasite—so weak, in fact, that its damage can practically be ignored. This race damaged cotton more severely than any of the other host plants, showing a pathogenicity index of 2.3 in Series I. There was a great deal of variation in the virulence of C between Series I and II, but since the greenhouse conditions were not adequately controlled it was impossible to even guess at the factors entering into this variation.

Race A is, on the whole, more virulent than either B or C and was able to parasitize all of the host plants employed in the experiment. It was most virulent on watermelon but caused severe damage to both tobacco and peanuts. Race B was intermediate between A and C in virulence, considering the whole set of host plants. B exhibited its greatest virulence on watermelon in both Series I and II. In Series I, however, its damage to the other plants, with the exception of *Primula,* was very slight. In Series II, B increased amazingly in virulence, causing much heavier damage to cotton and peanuts. Unfortunately *Primula* seedlings were not available for this series. It is impossible under the experimental conditions employed to consider intelligently the cause of this great increase in viru-

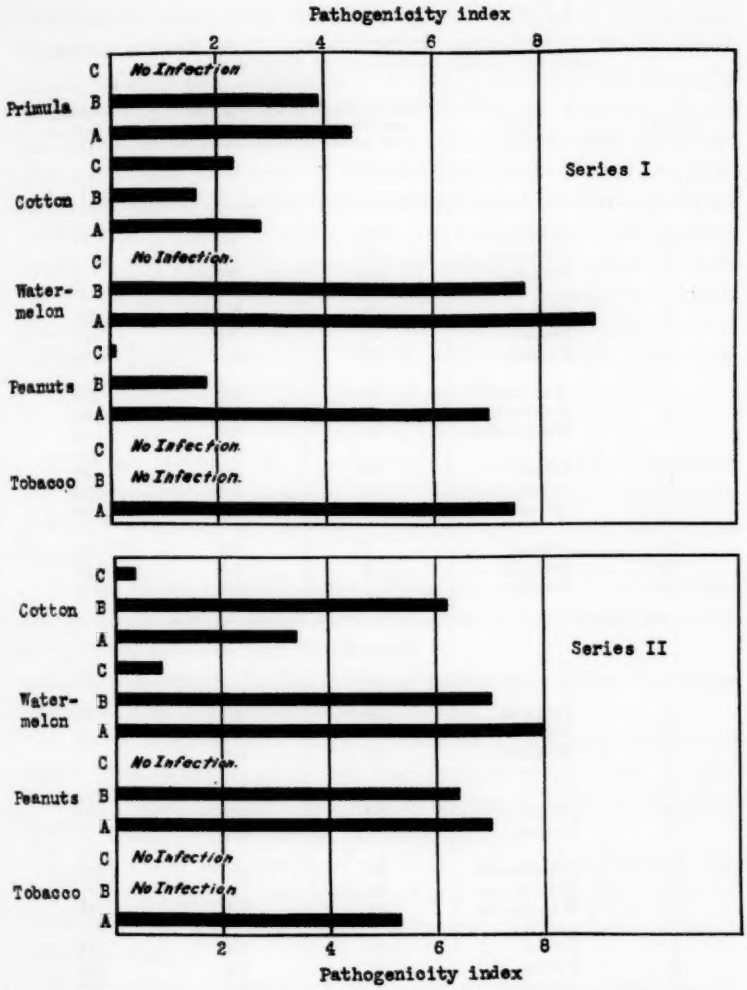


Fig. 10. Relative pathogenicity of races A, B, and C on various host plants.

lence. On the other hand, it does not seem out of place to mention one possible factor. Reference to table IV and fig. 5 indicates that lower temperatures are relatively more favorable to B than to either A or C and that high temperatures are rela-

TABLE X

SUMMARY OF INOCULATION EXPERIMENTS WITH THREE RACES OF *THIELAVIOPSIS BASICOLA* ON VARIOUS HOSTS

Race	Host	Number plants examined	Pathogenicity index	Percentage infection
		Series I		
A	Tobacco	100	7.5	91
B	Tobacco	100	0.0	0
C	Tobacco	100	0.0	0
A	Peanut	20	7.0	100
B	Peanut	20	1.8	90
C	Peanut	20	0.1	10
A	Watermelon	20	9.0	100
B	Watermelon	20	7.7	95
C	Watermelon	20	0.0	0
A	Cotton	20	2.8	90
B	Cotton	20	1.6	80
C	Cotton	20	2.3	60
A	*Primula*	5	4.5	60
B	*Primula*	9	3.9	56
C	*Primula*	7	0.0	0
		Series II		
A	Tobacco	98	5.3	94
B	Tobacco	125	0.0	0
C	Tobacco	130	0.0	0
A	Peanut	20	7.0	100
B	Peanut	20	6.4	100
C	Peanut	20	0.0	0
A	Watermelon	20	8.0	100
B	Watermelon	30	7.0	100
C	Watermelon	29	0.9	45
A	Cotton	20	3.4	95
B	Cotton	20	6.2	100
C	Cotton	20	0.4	20

tively more unfavorable to B. Recalling that Series I was exposed to rather high temperatures and Series II to cooler ones, there is a possible correlation in the soil temperatures and the variations in relative virulence exhibited by the races but it

must be conceded that this is not substantiated by all of the data.

The outstanding feature of this set of experiments was the failure of race B to infect tobacco. Although approximately 225 plants were examined carefully not a single sign of infection was noted. It is true, of course, that C also failed to parasitize tobacco but this is not surprising since C has proven to be such a weak parasite. B, however, has exhibited a much higher index of pathogenicity and has infected every plant tested except tobacco. These data indicate that B possesses certain inherent factors, foreign to those exhibited by A and probably different from those of C, which prevent it from infecting tobacco.

Summary

1. Three isolants of *Thielaviopsis basicola* were selected for study—one from tobacco in Tennessee (A), one from *Primula obconica* in Holland (B), and one from cotton in Texas (C).

2. The three isolants were distinctly different in cultural habits as shown by general appearance (color, zonation, type of mycelial growth, and sectoring).

3. Race C proved to be extremely variable in culture, A quite constant, and B intermediate.

4. Race A grew more rapidly on both Leonian's and onion agars than either B or C but was surpassed by C on potato-dextrose agar. The growth rate of B was a great deal below that of either A or C on all media used.

5. The rates of growth of all three races were greatly affected by the media but A showed the least reaction, while B grew better than C on Leonian's agar and C grew better than B on onion agar.

6. The effect of hydrogen-ion concentration on growth rates was greatest on B and least on A.

7. Chlamydospore production by race A was materially reduced at pH 7 and 8. B and C were only slightly affected.

8. B seemed to be better adapted to growth at lower temperatures than A or C.

9. The endospores of the three isolants of *Thielaviopsis basicola* showed differences in length and width on potato-dextrose agar which were statistically significant. Race A—width 4.15 ± 0.03, length 11.86 ± 0.19 μ; B—width 4.72 ± 0.55, length 15.64 ± 0.23 μ; C—width 4.32 ± 0.04, length 13.91 ± 0.25 μ.

10. Differences in endospore measurements of the same race on potato-dextrose agar and onion agar were statistically insignificant, with the exception of race B which showed slightly significant differences.

11. The chlamydospore chains of A were shorter and broader than those of B and C, and those of B were longer and narrower than those of C. The differences were statistically significant in every case. A—width 11.86 ± 0.03, length 32.36 ± 0.31 μ; B—width 10.1 ± 0.07, length 43.93 ± 0.23 μ; C—width 11.04 ± 0.05, length 36.1 ± 0.56 μ.

12. The chlamydospore chains of A were often borne in large clusters, those of B in groups of from one to three, and those of C usually singly or in pairs.

13. The individual spores of B were longer than those of A or C, and those of A were slightly longer than those of C.

14. Race A severely damaged tobacco, peanuts, and watermelon; infecting cotton and *Primula obconica* less severely.

15. Race B infected watermelon severely, damaged cotton more seriously than did A, affected *Primula* and peanuts slightly less than A, but failed entirely to infect tobacco.

16. Race C was an extremely weak pathogen, showing a slight infection of cotton, peanuts, and watermelon and not infecting tobacco or *Primula* at all.

17. The three isolants proved to be distinct physiologic races.

LITERATURE CITED

Allison, C. C. ('36). Physiologic specialization of *Thielaviopsis basicola* on tobacco. Phytopath. **26**: 1.

Berkner, F. ('37). *Thielavia basicola*, eine Gefahr für den Leguminosen Zwischenfruchtbau? Pflanzenbau **13**: 321–334. *12 figs., 3 diags.*

Brierley, W. B. ('15). The "endoconidia" of *Thielavia basicola* Zopf. Ann. Bot. **29**: 483–493.

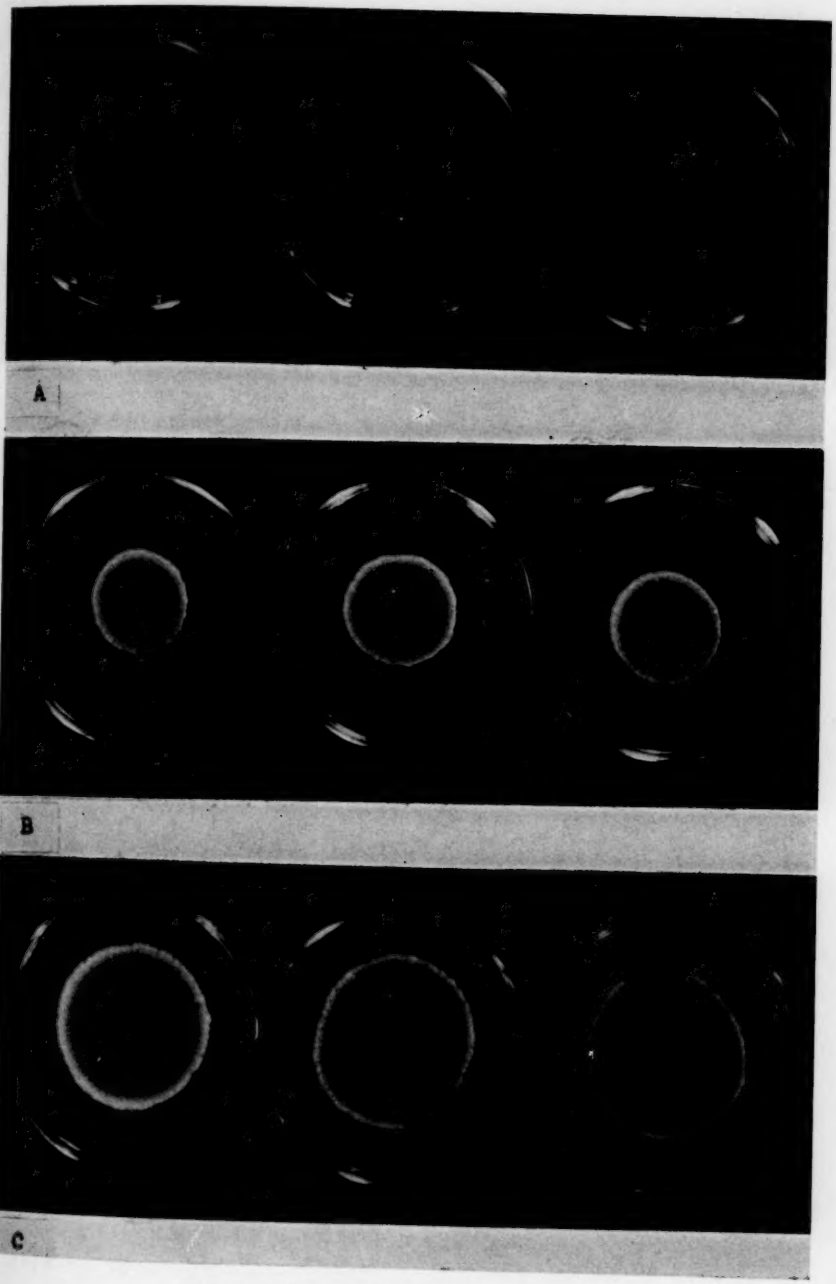
Johnson, E. M., and Valleau, W. D. ('35). Cultural variation of *Thielaviopsis basicola*. Phytopath. **25**: 1011–1018. *2 figs.*

Johnson, J. ('16). Host plants of *Thielavia basicola*. Jour. Agr. Res. **6**: 289–300.
————, and Hartman, R. E. ('19). Influence of soil environment on the root-rot of tobacco. Jour. Agr. Res. **17**: 41–86. *8 pls.*
Kentucky Agr. Exp. Sta. ('31). Rept. 1930. 48 pp.
Kletschetoff, A. N. ('26). [Russian with German summary.] Injury to flax caused by *Thielavia basicola* Zopf when the crop is grown uninterruptedly on the same soil. Jour. Scient. Agron. **12**: 823–834. [Rev. App. Myc. **6**: 420. 1927.]
Lambert, E. B. ('39). A spore isolator combining some of the advantages of the La Rue and Keitt methods. Phytopath. **29**: 212–214.
McCormick, F. A. ('25). Perithecia of *Thielavia basicola* Zopf in culture and the stimulation of their production by extracts of other fungi. Conn. Agr. Exp. Sta. Bull. No. 269: 539–554. *pls. 37–39, figs. 1–29.*
Ridgway, R. ('12). Color standards and color nomenclature. 43 pp. *53 pls.*
Riker, A. J., and Riker, R. S. ('36). Introduction to research on plant diseases. 117 pp.
Rosenbaum, J. ('12). Infection experiments with *Thielavia basicola* on ginseng. Phytopath. **2**: 191–196. *pls. 18–19.*
Sattler, F. ('36). Zur Biologie von *Thielavia basicola* (B. et Br.) Zopf. Phytopath. Zeitschr. **9**: 1–51.
Stakman, E. C. ('36). The problem of specialization and variation in phytopathogenic fungi. Genetica **18**: 372–389.
Taubenhaus, J. J. ('14). The diseases of the sweet pea. Del. Agr. Exp. Sta. Bull. No. 106. 93 pp.
Tiddens, B. A. ('33). Wortelrot van *Primula obconica* veroorzaakt door *Thielaviopsis basicola* (Berk. et Br.) Ferraris. Thesis. Rijks-Universiteit: Utrecht. 80 pp.

Explanation of Plate

PLATE 42

A. Colonies of race A on potato-dextrose agar nine days after inoculation.
B. Colonies of race B on potato-dextrose agar nine days after inoculation.
C. Colonies of race C on potato-dextrose agar nine days after inoculation.

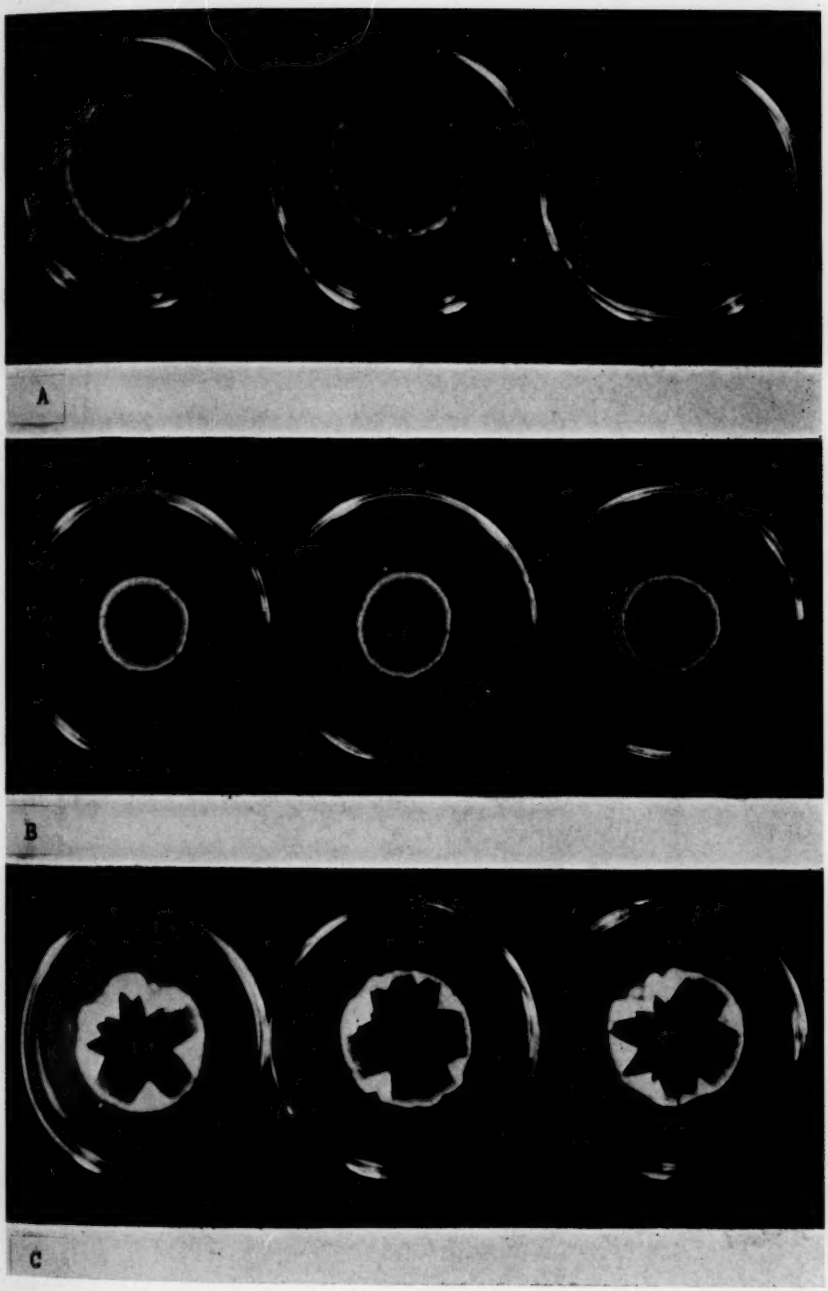


RAWLINGS—THIELAVIOPSIS BASICOLA

EXPLANATION OF PLATE

PLATE 43

A. Colonies of race A on onion agar nine days after inoculation.
B. Colonies of race B on onion agar nine days after inoculation.
C. Colonies of race C on onion agar nine days after inoculation.

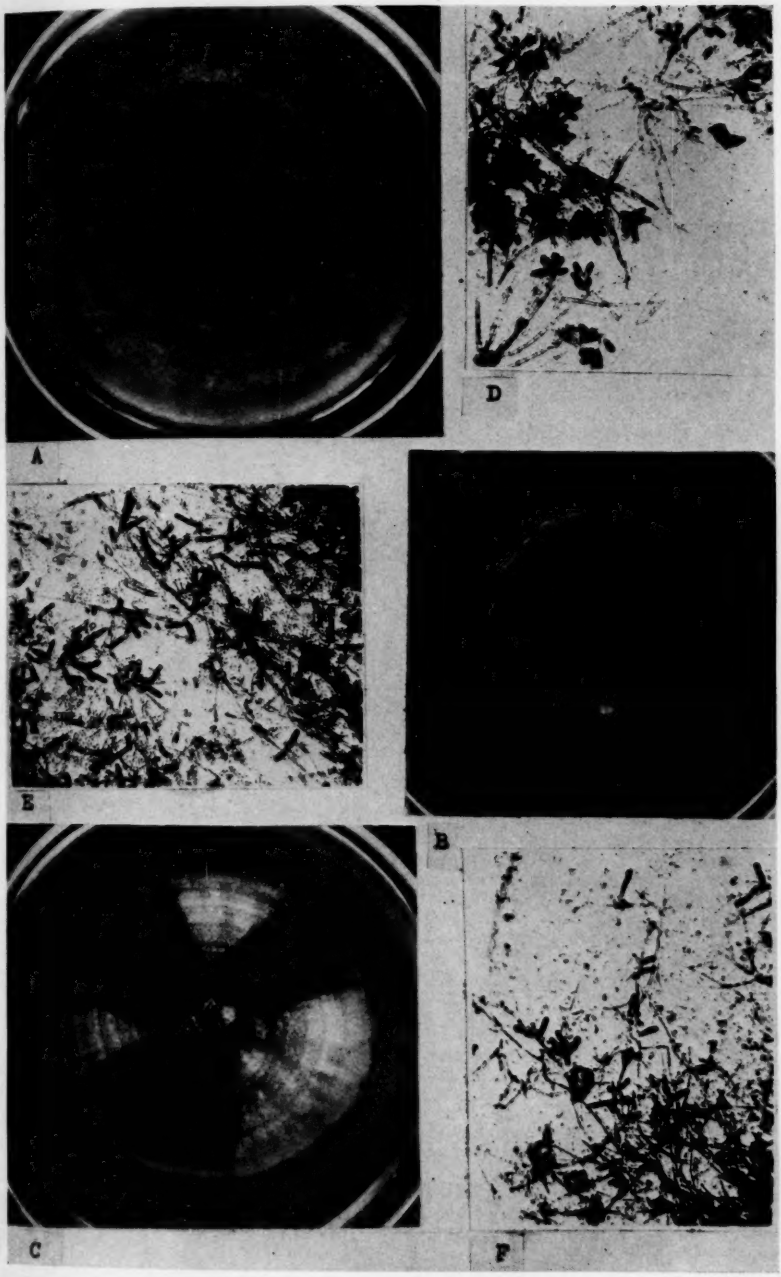


RAWLINGS—THIELAVIOPSIS BASICOLA

EXPLANATION OF PLATE

PLATE 44

A. Race A on Leonian's agar twelve days after inoculation.
B. Race B on Leonian's agar twelve days after inoculation.
C. Race C on Leonian's agar twelve days after inoculation.
D. Photomicrograph of chlamydospores of race A on potato-dextrose agar.
E. Photomicrograph of chlamydospores of race B on potato-dextrose agar.
F. Photomicrograph of chlamydospores of race C on potato-dextrose agar.



RAWLINGS—THIELAVIOPSIS BASICOLA

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